SUDAN GOVERNMENT

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MINISTRY OF AGRICULTURE

ANNUAL REPORT

OF THE

RESEARCH DIVISION

1949/1950

McCorquodale & Co. (Sudar) Ltd.
1952

COMMONWEALTH MYCOLOGICAL INSTITUTE
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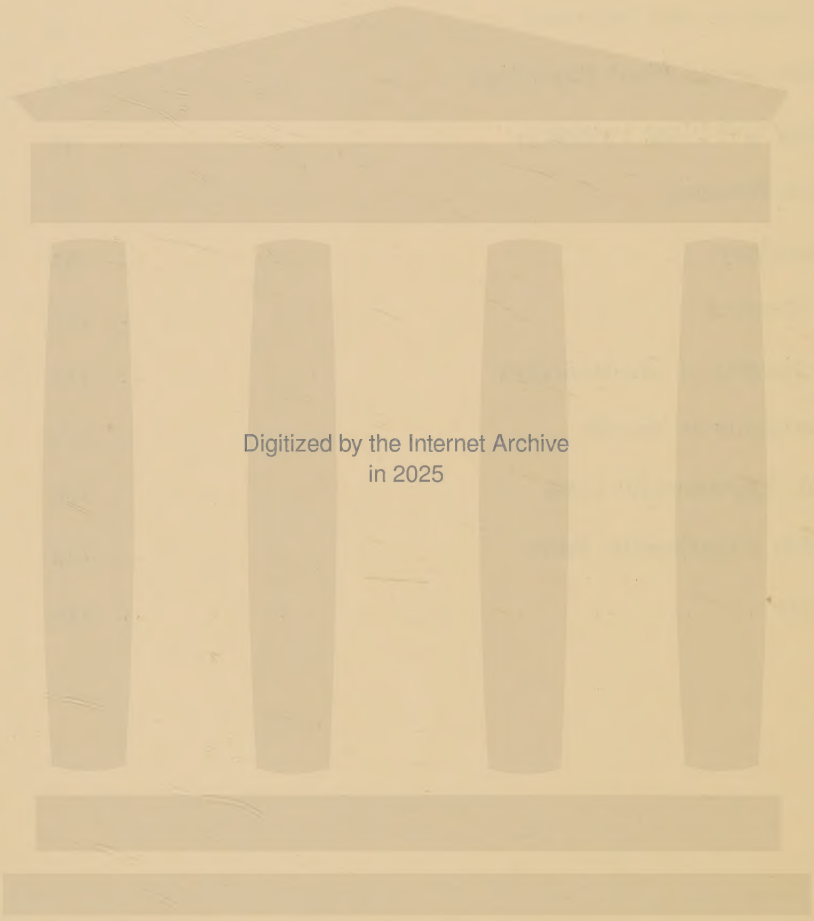

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RESEARCH DIVISION.

List of Senior Staff in Season 1949/50.

Chief of the Research Division	R. C. Maxwell Darling, B.A.
Assistant Chief and Chief Chemist	T. N. Jewitt, Ph.D.
Inspector (Administration) ..	T. G. Harding.
Librarian	W. J. Plumbe, F.L.A.

Agronomy and Plant Physiology Section.

Chief Agronomist	H. Ferguson, B.Sc. (Agric.), N.D.A., N.D.D.
Agronomist	S. Gray, B.Sc., Dip. Agric. Sc. (Cantab), Dip. Agric., A.I.C.T.A.
,, ...	H. D. Fowler, B.Sc.
Plant Physiologist	*Vacant.*
Farm Manager	M. C. Hattersley.

Botany and Plant Pathology Section.

Chief Economic Botanist ..	F. W. Andrews, B.Sc. (Lond.), Ph.D., A.R.C.S.
Economic Botanist	K. Wilson Jones, M.Sc.
Plant Pathologist	S. A. J. Tarr, B.Sc.

Entomology Section.

Government Entomologist ..	R. J. V. Joyce, M.Sc.
Entomologist	W. S. Richards, M.A., Ph.D. (Oxon).
,, ...	D. G. Pollard, B.Sc.
,, ...	*Vacant.*
,, ...	*Vacant*
,, ...	*Vacant*
Inspector, Pest Control ..	Beshir Babiker el Shafie

Cotton Breeding Section.

Chief Cotton Breeder	.. R. R. Anson.
Senior Economic Genetecist	.. R. L. Knight, M.Sc. (Agric), D.Sc., Ph.D., A.I.C.T.A., D. Agric. (Wye).
Senior Cotton Breeder	.. M. F. Rose, M.A. (Cantab), A.I.C.T.A.
Cytogenetecist ..	.. H. Douwes, Ph.D. (Groningen).
Cotton Breeder ..	.. K. C. Barlow, B.Sc. (Agric.).
Cytogenetecist ..	.. R. L. Cuany, B.A. (Cantab).
Economic Genetecist	.. J. E. W. Sadd, B.Sc.
Inspector, Plant Propagation	C. G. Webster.

Soil Research Section.

Chief Chemist	.. T. N. Jewitt, Ph.D.
Chemist..	.. T. A. Jones, B.Sc., A.R.I.C.
,, ...	.. K. R. Middleton, B.Sc., A.R.I.C.

Equatoria Development.

Senior Research Officer	.. P. de Schlippe, A.G. (Gembloux).
Agronomist	.. K. R. M. Anthony, B.Sc., A.I.C.T.A.

Central Rainlands Development.

Agronomist	.. *Vacant.*
Plant Breeder ..	.. *Vacant.*

GLOSSARY

1 Feddan	=	1.038 acres = 4200 sq. metres.
1 Rotl	=	0.99 lbs.
1 Kantar of Seed Cotton	=	315 rotls.
Abu Ashreen	=	A watering channel leading from a large canal.
Abu Sitta	=	A small watering channel leading from an abu ashreen.
Angaia	=	Sub-division of a plot of land bounded by a gadwal and a tagnet.
Anis	=	The grass *Sorghum purpureo-sericeum*, Aschers and Schweinf.
Asal	=	Honey. Term used for stickiness on plants.
Beladi	=	Native.
Berseem	=	Lucerne (*Medicago sativa*).
Bildat	=	Land, usually near a village, which is cultivated for several years in succession.
Dukhn	=	Bulrush millet (*Pennisetum typhoideum*, Rich.).
Dura	=	Giant millet (*Sorghum vulgare*, Pers.).
Gadwal	=	The smallest watering channel, leading from an abu sitta on to the land.
Gassab	=	Dura stalks.
Goz	=	Sandhill.
Hafir	=	Pit dug in the ground to collect rain water for use in the dry season.
Harig	=	A system whereby old, dry grass is burnt to kill off germinated weeds before sowing the crop.
Hawasha / Hosha	=	The unit holding in the Gezira Scheme. In the case of cotton, 10 feddans.
Kharif	=	The main rainy season.
Khor	=	Watercourse with seasonal flow.
Komodob	=	Land under crop, which also bore a crop in the previous year.
Lubia	=	The fodder bean, *Dolichos lablab*, Linn.
Number	=	Unit of land irrigated by an abu ashreen in the Gezira Scheme, usually 90 feddans.

Sagia	=	Land watered by a water wheel, or the water wheel itself.
Seluka	=	Native sowing stick.
Tagnet	=	Ridge for controlling watering.

Abbreviations.

G.R.F.	=	Gezira Research Farm.
K.C.C.	=	Kassala Cotton Company Ltd.
S.P.S.	=	Sudan Plantations Syndicate Ltd.
k.p.f.	=	Kantars per feddan.
r.p.f.	=	Rotls per feddan.
G.O.T.	=	Ginning out-turn (as percentage of seed cotton).
S.E.	=	Standard error.

RESEARCH DIVISION

MINISTRY OF AGRICULTURE.

ANNUAL REPORT FOR 1949/50

INTRODUCTION AND SUMMARY.

Staff.

Dr. T. N. Jewitt was promoted to be Assistant Chief of Research, while remaining Chief Chemist. Mr. D. G. Pollard joined the Entomological Section and Dr. G. Morcos of the Egyptian Government worked with the section for 6 months. Mr. D. W. Mollison (of Pest Control Ltd.) again worked on shedding problems at Tokar. Mr. H. D. Fowler joined the Agronomy and Plant Physiology Section. Mr. J. E. W. Sadd of the Empire Cotton Growing Corporation joined the Cotton Breeding Section as Geneticist, and Dr. H. Douwes and Mr. R. L. Cuany as Cytogenetecists.

Egyptian Cotton.

YIELDS.

The yields in the last five seasons have been as follows in kantars per feddan.

	1945/46	46/47	47/48	48/49	49/50	Variety
Gezira ..	3.36	3.93	3.39	4.26	4.58	S & L.
Gondal	4.73	3.26	3.81	4.35	2.45	L
A/Magid ..	3.00	3.00	3.07	4.01	4.61	L
Dueim	2.28	2.72	2.83	3.75	3.98	L
Fatisa	1.95	1.92	3.62	4.69	4.48	L
Hashaba ..	2.00	1.64	4.01	4.46	4.32	L
Um Gerr ..	2.69	3.78	3.25	4.37	4.67	L
Wad Nimr ..	3.32	2.83	2.91	5.81	6.37	L
Tokar	2.27	1.81	2.40	1.35	1.13	L
Gash	1.52	1.81	2.20	2.23	2.30	S & L

In the Gezira the actual yield was 50 per cent higher than that forecast from the rainfall formula.* This is the first serious discrepancy since 1933/34, and the only explanation put forward is the large increase in spraying against jassids and manuring, the total areas being 126,000 and 77,400 feddans respectively (p. 19). The grade of the Gezira crop was better than for several seasons past.

* see 1948/49 report, P. 5.

Yields of Abdel Magid and the White Nile Schemes were all good. All the land was manured and nearly all sprayed. Gondal suffered from jassids but was not sprayed.

In the Gash, the area watered was large, considering that the flood was rather small. Yield and quality were good. Sakel was mostly sown on the 2nd rotation, but the earlier-sown cotton yielded better than the late-sown. This is unusual and may be due to the comparative absence of leaf curl.

In Tokar Delta the flood was late and below average in volume. The autumn and winter rains failed completely and this, combined with attack by various pests, caused a poor yield.

Gezira Weather 1949/50.

The July and August rainfall at the G.R.F. was the lowest since records started in 1919, and rains were very poor over much of the Scheme. The weather was exceptionally hot during the rainy season, but the winter was about average, apart from December which was colder than average.

Insect Pests.

Jassids.

Severe infestation was much more widespread than usual in the Gezira, and correlated with the poor rains, which supports Hanna's mud-splash theory. Damage was very serious on unsprayed fields, and the overall increase from spraying was estimated at between 1.4 and 1.7 k.p.f. Private schemes on the White Nile which were not sprayed also suffered. Population in the Gash and Tokar was high but little damage occurred in the Gash, and there were only patches of moderate damage at Tokar. Field investigations now indicate that alternate host plants may prove of more importance in jassid control than had been thought previously. Further work was done on parasites (p. 89).

Other Insects.

Pink bollworm was bad again in the Gash, reaching a high infestation late in the season, and the Sudan bollworm was also quite bad. Egyptian bollworm caused much bud shedding at Tokar. Pink bollworm was about average in the Gezira.

Thrips did little damage in the Gezira. Busata, a new pump scheme on the Blue Nile, south of Sennar, suffered severely; as it also had a bad attack of blackarm and jassids, Busata had an unfortunate first season. Damage from thrips was general throughout the Gash, but not severe.

Aphis was again very serious at Tokar. Infestation became widespread in March and continued until the hot weather began in May.

Flea beetle was very bad in the Gezira, as was to be expected from the poor rains. 3 tons of B.H.C. dust were distributed from the one power duster available, but the area affected was too great for this to have much effect, and a large amount of resowing was necessary.

Termites were bad in patches at Tokar in March, and Creontiades caused a considerable amount of bud shedding.

Caterpillars attacking cotton seedlings were a serious pest in the Gash and to a lesser extent at Tokar. This is an unusual occurrence.

DISEASES.

Blackarm.

Blackarm was light in the Gezira Scheme except for a few small areas. Breeding plots, which were sown with seed from heavily infested plants of the previous season, had a bad attack of blackarm. They had been treated with extra-strong Abavit which shows that even this dry dressing is not good enough for heavily infested seed, for which only the liquid treatment seems to be effective (p. 48). In the Gash Delta, the incidence of the disease was extremely light. The new pump scheme at Busata had a bad attack, and this was probably connected with other cotton which was grown in this area (p. 50). Work on seed disinfectants was continued, and the effect of various methods on germination was investigated (p. 51). Deep discing of the land showed promise as a method of reducing secondary infection from debris lying on the ground. (p. 52).

Leaf Curl.

Leaf curl incidence was very light in the Gezira Scheme and lighter than usual in the Gash Delta. Whitefly were fewer than usual in both areas. Transmission experiments from Sakel to various American cottons and other Malvaceae were carried out. (p. 52). Hormone weed-killers were tried as a method of killing the roots of cut plants to avoid the necessity of pulling out the plants, but were not promising (p. 53).

FIELD EXPERIMENTS.

G.R.F. Yields.

Presowing rains were poor as in other parts of the Gezira, and there was much more jassid damage than usual, and very few plots were sprayed. Considering this, yields, particularly of 1730 were better than was expected. Excellent yields of 1730 were obtained at the south end, but rainfall had been better here and there was less jassid damage, and the land is richer.

Plot 57 gave a better yield than in the two previous seasons. It was sprayed but the yield was much less than the average of the total S.P.S. area, of which 63 per cent was sprayed. Up to 1946/47 season the yield of this plot was always more than the Gezira average. Comparison of the soil of plot 57 with an adjacent plot on the same rotation but without manuring revealed no unusual features in the profile nor in alkalinity, salts or nitrates. (p. 110 and 1948/49 Report, p. 9).

Weed Observations on Fallow Hoed Areas.

It was found that the number of weeds germinating on fallows which had been hoed in previous years was less than in those which had never been hoed, even where the land had borne two crops in the intervening period. There were further examples of wind erosion on hoed land, but not where ploughs had been used. Some more data was obtained on possible changes of the weed flora in relation to fallow hoeing and grazing (p. 43).

Control of Land Weeds.

Hormone weed killers, Denocate and hand-hoeing of fallow weeds at different times were compared. As in the previous season the hormones had a slower but more lasting effect than Denocate or hand hoeing. There was no significant difference in cotton yields the following year, except that two applications of the weed killing treatments proved better than one (p. 22).

Deep discing with large discs gave promising results as a method of controlling seid (nut-grass) which is the major weed of irrigated land (p. 41).

Effect of Weed Killers on Soil Fungi and Bacteria.

Certain soil fungi and bacteria were isolated and tested for the effect of Chloroxone and Methoxone. It does not appear likely that the weed killers would have any permanent harmful effect on the fungi and bacteria, at least in doses at present envisaged (p. 54).

Watering Experiments.

Large scale experiments were again carried out in the Gezira and White Nile Schemes on the effect on yield of stopping watering early. In this season 10 feddan fields, which were comparable by reason of similar cultural treatment and past yields, were used as the units of comparison. The effects of the early closure varied from a gain of 0.68 k.p.f. to a loss of 0.84, the average being a small loss. It is felt that large scale experiments cannot be planned more accurately, and that the evidence from the last 3 seasons indicate that a small loss of yield may be expected from early closure.

An experiment on lengthening the interval between waterings from 16 to 24 days was also carried out. But there was no apparent saving in water consumption, the achievement of which is the object of these experiments.

Grade Experiments.

Grading of pickings from different parts of the plant showed that the crop from the bottom of the plant is better than that from the top. Indications are that the earliness of the bottom crop is the important factor. (p. 28).

No significant correlation between plant characters and grade was found, but some association was found between meteorological conditions and grade indicating that a hot dry October and a cool November result in good grade (p. 28).

A large scale experiment carried out by the S.P.S. Ltd. showed improved grades from early sowing and wide spacing (p. 58).

Effect of Presowing Rains on Yield.

An experiment was carried out to study the effects of applying water in the presowing period with a sprinkler to simulate rain, and by ordinary irrigation. The sprinkler gave an increase in yield over the irrigation, and the irrigation over the control. Unfortunately irregularities in the plot and certain practical difficulties in the application of the treatments resulted in a high error, and the differences were not significant. Observations were made on soil moisture, nitrates, weed growth and plant characters throughout the season, but the latter did not seem to show much difference between the treatments. It is pointed out that sprinkling does not produce the climate (above ground) of a good rainy season (p. 25).

Cotton Varieties.

The policy of breeding strains of the 2 main varieties resistant to blackarm, leaf curl and jassids continued, but some other breeding work was done and certain experiments. The difference between Evelyn's Selected Domains Sakel and the regular strain were again too small to be significant. *BAR X1730L gave satisfactory results as regards yield and quality. Selection work was done at the G.R.F. on 2 strains of Sakel and 6 strains of 1730 for resistance to diseases and jassids, and selection for earliness was begun on Sakel.

The ratooning experiment to select increased resistance to leaf curl was continued. Only some of the susceptible spreaders showed symptoms of the disease up to the middle of April. After cutting back, nearly all the spreaders showed symptoms, and the percentage of plants of the different resistant strains which showed symptoms varied between 7 and 42 per cent (p. 59).

In breeding work at Shambat the production of blackarm resistant Sakel was completed, and BAR breeding in 1730 was completed as regards hybridisation. Breeding of hairy Sakel for jassid resistance was carried a stage farther. The 4 loculed boll character is being transferred to Egyptian cotton to offer more scope for selection for higher yield (p. 62).

American Cotton.

YIELDS (k.p.f.).

	1948/49	1949/50
Zeidab (irrigated)	3.60	3.78
Kordofan (rain grown) ..	0.98	0.84
Equatoria (rain grown) ..	1.13	1.20

* See glossary of cotton varieties on p. 78

The area in Kordofan increased to 76,000 feddans, but yields were poor owing to badly distributed rains and pests. In Equatoria the area increased to 12,600 feddans, and the crop began very well; but a severe attack by insect pests reduced the yield considerably. Good yields were obtained at the Yambio Experimental Farm on plots which were inadequately weeded (p. 135).

Pests and Diseases.

Bollworms and stainer-bugs caused much damage in Kordofan, notably the pink bollworm. Efforts are being made to enforce the removal of standover cotton. Blackarm was present throughout the crop ; the disease did not appear to have much effect on yield, but, when it gets into bolls, it causes staining, which is often confused with that caused by stainer-bugs.

In Equatoria, there was heavy shedding of buds and small bolls, much of which must have been caused by insects. Egyptian and pink bollworms, and stainers, *Helopeltis* and jassids were all worse than usual.

Cotton at the Khor Kafai Experimental Farm (in the higher rainfall area of Gedaref District) was devastated by thrips.

Cotton Varieties.

It is considered that BAR SP. 84, the variety grown in Kordofan and Equatoria, has insufficient variability for future selection work. A programme of hybridisation with another strain, which is homozygous for the blackarm resistance gene B_2 has therefore been undertaken (p. 67).

BAR 7 8, a derivative of SP. 84 which yields well and is very resistant to blackarm, has shorter and harsher lint than SP.84. Selection work to improve the quality has been begun (p. 68). BAR 7/8 yielded well in a variety trial at Yambio, but SP 84, which was not included in the variety trial, gave a much higher yield in the Catena Fertility Trial.

Experiments.

In the multifactor experiment at Kadugli. the close intra-row spacing of 45 cms. significantly outyielded the commercial spacing of 90 cms. for the fourth year in succession. Yields increased directly with number of plants per hill, all possible comparisons being significant. (p. 69).

Experiments at Yambio support the theory that damage to seed by stainer bugs is responsible for poor germination. (p. 134).

Experiments with different watering treatments were again carried out on the Khor Abu Habl in Kordofan. Ponding the land for 10 days, then draining and sowing, was found to be a suitable method, as yields were satisfactory, and no weeding was necessary (p. 119).

Dura and Other Grain Crops.

Yields.

Yields in the Gezira Scheme were good, and were above average at the G.R.F. (1500 rotls per feddan on the 8 course rotation). Abdel Magid averaged 1,380 r.p.f. and the White Nile Schemes 1600—2240.

In the northern part of the main rain-grown dura belt, yields were very poor owing to lack of rain. At the Mechanised Crop Production Scheme, Ghadambaliya, near Gedaref, only 300 r.p.f. were obtained, but even this was better than the local harig crop, which was mostly slow maturing varieties which produced nothing. At Khor Kafai, in the southern, heavier rainfall area of Gedaref District, mechanised cultivation methods produced yields of up to 1700 r.p.f.

Pests.

Swarms of the desert locust appeared in the interior of the Sudan in the summer of 1950, after being practically absent for 2 years.

The explosives campaign which was carried out early in 1949 against the Sudan Dioch showed its effect, as the numbers of birds in the area east of the Blue Nile was markedly small. Nesting sites were very small compared with previous years, and reports of damage referred to a few small areas only. A tour was made of the White Nile —Bahr el Ghazal area and recommendations for controlling the birds in that area were put forward.

Grasshoppers caused severe damage to seedlings in parts of Fung and Gedaref Districts and, later in the season, did considerable damage to milky grain in Gedaref District. Observations this season support the conclusions arrived at in previous years that the main breeding area of *Aiolopus savignyi* is the area north of the cultivation zone in Gedaref District. (p. 90).

Cutworms (*Laphygma exigua*) severely damaged ripening eleusine in parts of Tembura District (S.W. Equatoria).

Experiments.

Efforts are being made to find a suitable variety of dura for the high rainfall areas of Equatoria. The problem of successful storage there has recently come to the fore, and a suggestion has been put forward that some difficulties might be overcome by growing a variety with a long vegetative period, so as to reduce the period of storage during the rains (p. 136).

Many tenants on the White Nile Schemes manured their dura with ammonium nitrate with good results.

An experiment of discing the land during and after the 1948 rains for cropping in 1949 was carried out at Ghadambaliya. It showed that discing during the 1948 rains, combined with November discing, gave large increases in yield in 1949. This is almost certainly due to the effect of the discing on soil moisture (p. 112).

In the watering experiments at the Abu Habl, yields of dura seemed to depend more on sowing date than on watering treatment

Hormone weed killers were successful in killing the dicotyledonous weeds of 2nd year cultivated land at Ghadambaliya, but were ineffective against the grasses of virgin land (p. 115).

At Khor Kafai, for all varieties and for both sowing dates, 2nd year land yielded better than virgin land and early sowing was better than late sowing. This applied to other crops as well as dura.

Legumes.

The poor rains were beneficial to July-sown, irrigated lubia in the Gezira, as there was little bacterial disease which normally damages the early sown crop, and also no waterlogging. Good yields of up to 20,000 r.p.f. of fresh fodder were obtained at the G.R.F. In the fodder rotations, dura preceding lubia depresses the yield of the latter unless there is an intervening fallow (p. 33). Sunn hemp grown with lubia had the effect of lifting the lubia vines off the ground, which should make mechanical cutting a possibility. (p. 35).

Various legumes were tried in the Gezira with the idea of replacing the present fallow weeds with better fodder, even if it required a little irrigation (p. 34).

Seven special bulks of cowpea resistant to leaf mosaic have got to the stage of bulk propagation at Kadugli. Cowpeas are an important crop in that area.

Of fodder legumes at Yambio, Brazilian lucerne was again successful, and Samoan clover looks promising. Ordinary lucerene showed an ability to recover after drying up during the dry season. (p. 137).

Oil Seeds.

Groundnuts. Yields in Kordofan were poor, as the rains failed on the light soils. Mechanised production at Sungikai produced only 100 r.p.f., but the surrounding crop gave nothing. Progress has been made in finding suitable implements for the area. Barberton proved better than the local variety for the second year in succession. A high seed rate (54 r.p.f.) was found necessary to allow for termite damage. Seed treatment with Agrosan seemed to improve germination and emergence of seedlings. Yields at Khor Kafai were poor, mainly due to a severe attack by thrips.

Sesame. Good yields of up to 528 r.p.f. were obtained at Khor Kafai. The two Kadugli types which are resistant to the bacterial disease, Marad el Dam, are now ready for bulk propagation. Observation plots of several varieties were grown at Yambio.

Sunflower. Sunflower grew well at Khor Kafai and produced large heads, but 90 per cent of the seeds were empty. Experimental plots at Kodok, in the Upper Nile Province, yielded 765 r.p.f. A dwarf (4 ft.) variety, Saratov, yielded 1300 r.p.f. on small irrigated plots at the G.R.F. Observation plots at Meridi and Yambio gave yields of 800—1480 r.p.f. At Yambio the sunflowers suffered from rust.

Safflower. Propagation plots on the G.R.F. gave 1526 r.p.f. for the local spiny variety and 1429 and 1112 for two spineless introductions. Three caterpillars attacked leaves and fruit of safflower at Ghadambaliya and Khor Kafai causing serious damage.

Soya. A large collection from the Belgian Congo was sown in observation plots at Yambio and selections for further trial were made on a basis of vegetative vigour, yield and palatability. Propagation during the rains was a failure at the G.R.F. owing to blister beetles and termites. Plots sown in the winter were successful; the non-shattering varieties compared unfavourably with the shattering varieties.

Castor. Observation plots of a number of varieties were grown at Yambio. All varieties produced oil of good quality.

Fibre Crops.

Trials were continued with jute and Deccan hemp at Meridi. As in the previous season, Deccan hemp gave the highest yield of fibre and the longest fibres. (p. 126).

Chemical Control of Canal Weeds.

Success was achieved with Fernoxone and Methoxone applied as powders, both vegetative growth and seeds being killed in the small experimental canals, which remained free of floating weeds throughout the season. Most of the chemical seemed to have been decomposed a month after treatment, but slight effects were noticed up to 55 days, being tested by watering dura seeds with water from the treated canals. (p. 42).

It was decided to carry out a large scale trial at the end of the cotton season.

Soil Research.

Soil surveys were made in the Blue Nile Province, Tokar Delta, several parts of Equatoria and also in Jordan at the request of the Jordan Government. Very deep sampling was done at Yambio to study the distribution of nutrients with depth as this may be connected with the restorative effect of a bush fallow.

A significant negative correlation has been established between mean August and September soil nitrates and pre-sowing rains. Nitrates at sowing time were very high in 1949 after the poorest presowing rains on record. (p. 102).

Measurement of carbon dioxide evolved from soil indicates that bacterial activity in the period after sowing cotton was greater than usual in this season of light presowing rains. (p. 107).

Work continued on the carbon-nitrogen ratio, and on changes of the nitrogen content of the soil during the year. (p. 108).

Work on soil moisture was continued in the rainlands and the Abu Habl Scheme.

Miscellaneous.

Professor R. H. Dastur O.B.E., visited the Gezira, at the invitation of the Ministry, to advise on the phenomenon of ' bad boll-opening '.

The organisation of the library progressed on improved lines (p. 140).

Routine pest control measures were carried out, also trials of certain insecticides and spraying apparatus. Plant Quarantine continued on the same lines, and a summary report is included. (p. 91—99).

Publications During 1949.

FERGUSON, H. The Zande Scheme (Empire Cotton Growing Review, 26, pp. 109—21.).

COWLAND, J. W. and EDWARDS, C. J. Control of *Empoasca libyca*, de Berg on Cotton in the Anglo-Egyptian Sudan. (Bull. Ent. Res., 40, pp. 83—96.).

DARLING, H. S. Cotton Growing at Zeidab, Northern Sudan and the Control of *Laphygma exigua*. (Empire Cotton Growing Review, 26, pp. 271—7).

KNIGHT, R. L. The Distribution of Wild Species of *Gossypium* in the Sudan. (Empire Cotton Growing Review, 26, pp. 278—85).

WILSON, C. E. Butterflies of the Northern and Central Sudan. (Sudan Notes and Records, 30, pp. 222—44).

JEWITT, T. N. Soil-Fertility Studies in the Zande District of the Anglo-Egyptian Sudan. (Commonweath Bureau of Soil Science Technical Communication No. 46).

JEWITT, T. N. and BARLOW, H. W. B. Animal Excreta in the Sudan Gezira. (Empire J. Experimental Agric., 17, pp. 1—17).

R. C. MAXWELL DARLING,

CHIEF OF THE RESEARCH DIVISION.

16*th September*, 1951.

AGRONOMY AND PLANT PHYSIOLOGY SECTION.

By H. Ferguson and S. Gray.

I. Introduction.

The staff position in the Agronomy and Plant Physiology Section remained unchanged during most of the 1949/50 season. Mr. H. D. Fowler joined the staff in December 1949, and though too late to take part in the season's programme of work he was able to carry out some exploratory work likely to be of value in the 1950/51 programme.

As in previous years the staff of the Section were able to carry out a large number of field experiments, but full interpretation of the results of these must await the arrival of more research workers.

The following is a complete list of the field experiments carried out in the 1949/50 season.

I. Gezira Research Farm—Permanent Experiments.

Item No.	Experiment	Date Started
Rotation Experiments. (*Cotton, dura, lubia*).		
1.	Continuous Cotton	1918
2.	Two Course Rotations	1918
3.	Three Course Rotations	1926
4.	Combined Rotations	1930
5.	New Rotations Experiment	1941
6.	Fodder Rotations Experiment	1945
7.	Influence of Fallow Weeding on Rotations	1941
Observation Plots—(*Cotton*).		
8.	Old Observation Plot	1927
9.	Gezira Observation Plot	1939
10.	Gash Soil Experiment	1931
11.	Root Investigations	1944

Item No.	Experiment	Date Started
	Fallow Hoeing Experiments.	
12.	Permanent Fallow Hoeing (Cotton) ..	1946
13.	Permanent Fallow Hoeing (Dura)	1946
	Manuring Experiments (Cotton and Dura).	
14.	New Organic and Green Manure	1944
15.	Types of Nitrogen Experiment	1939
16.	N.P.K. Experiment	1941
17.	Residual Nitrogen	1941
18.	Farm Yard Manure	1935
19.	Permanent Fallow	
20.	Miscellaneous Fallow Weeds	1945
	Perennial Crops.	
21.	Citrus Manuring Experiment	1945
22.	Other Citrus Plots	1945
23.	Forests	
24.	Guava Plots	1948
25.	Mango Plots	1950

II. Gezira Research Farm—Prepared Experiments and Residuals.

Item No.	Experiment	Date Started
	Fallow Weed Experiments—(Due for cotton 49/50)	
1.	Fallow Hoeing and Manuring	1949
2.	Weed Killer Trial	1948
	Fallow Weed Experiments—(Due for fallow 49/50)	
3.	Fallow Hoeing and Manuring	1947
4.	Weed Killer Trial	1948
	Residuals.	
5.	Residual effect on dura, of hoeing and irrigation of double fallow before cotton crop of 1947/48.	1945/46

III. Gezira Research Farm—New Experiments.

Item No.	Experiment
1.	Pest Control Experiment (in co-operation with Entomological Section).
2.	Observation Plots of various legumes and other plants on irrigated and fallow plots.
3.	July/August Rainfall Effect.
4.	Investigation of effect on boll opening and boll shedding of certain artificially induced soil and microclimatic conditions.
5.	Special Picking in Observation Plot.

IV. Outstations.

Item No.	Experiment	Date Started
	Kab el Gidad.	
1.	Gezira Observation Plot	1939
2.	Pest Control Experiment	—
	Abu Guta.	
1.	Gezira Observation Plot	1945
2.	Pest Control Experiment	—
	Hag Abdulla.	
	Gezira Observation Plot	1939
	Abdel Hakam.	
	Testing Area	1944
	Seleimi.	
	Testing Area	1939

The section carried out the usual observations, samplings, analyses, and statistics associated with the field experiments. It was found possible to bring up to date summaries of Gezira Observation Plot observations, and to make lists of contents and to index the section's vast accumulation of experimental records and technical data. This latter was no mean task, a total of 1325 files having been sorted. Though of no immediate productive value it should greatly facilitate the work of the staff.

During the season the agronomist worked out and checked all past yields of the "agronomy" long term experiments, and put in order much of the basic data concerning these. In view of frequent past changes in supervision and organisation of these experiments this was very necessary, and an important preliminary to the interpretation of their results. The agronomist also made a study of "basic" yields of Sudan Plantations Syndicate blocks, and of the Seleimi rotation comparison. As in previous years the Section co-operated with the S.P.S. in their experiments, and assisted the Alternative Livelihood Schemes with their crop recording and experimental work.

The most abnormal feature of the 1949/50 season was the very light presowing rains. The July 1—August 15 total of 68.3 mms. was the lowest on record (30 years), and only one third of the average. This was accompanied by hot dry weather which persisted after sowing. Rainfall, temperatures, and humidity at the Gezira Research Farm are summarised in the following table.

The report has been reduced to a reasonable size by omitting all normal results of permanent and long term experiments. These can be considered more usefully when the experiments are completed.

G.R.F. Meteorological Data.

	Max. Temp.		Min. Temp.		Rel. Hum.		Evap. Piche	
	Av.	Mean	Av.	Mean	2 pm Av.	2 pm Mean	8 am Av.	8 am. Mean
	1949	19/42	1949	19/42	1949	22/42	1949	19/42
May 1949 ..	40.6	41.0	23.9	23.7	18	15	19.1	20.3
June 1949 ..	39.7	39.7	24.0	24.4	21	22	19.2	18.6
July 1949 ..	37.7	35.6	23.9	22.5	28	38	15.9	11.7
August 1949 ..	35.8	33.5	22.1	22.0	37	49	9.5	7.1
September 1949	36.0	35.8	21.5	22.0	34	39	9.4	8.3
October 1949 ..	38.6	38.5	21.7	21.9	23	23	12.0	11.9
November 1949	36.7	36.8	17.7	18.2	14	16	15.3	14.9
December 1949	31.5	34.5	11.8	15.2	15	17	12.9	14.4
January 1950 ..	34.3	33.9	13.9	14.2	14	16	15.1	15.3
February 1950	35.0	35.4	14.5	15.1	12	12	17.0	17.9
March 1950 ..	38.5	38.4	18.4	17.7	9	8	21.4	21.2
April 1950 ..	41.1	41.1	22.5	20.9	10	9	21.5	23.0

II. Cotton.

Establishment, Growth, Yield and Grade of 1949/50 Crop.

Gezira Research Farm Crop.

The rainfall during July and Augut was even lighter at the Research Farm than in most of the Gezira. It was insufficient to disintegrate clods and to close cracks. This necessitated general prewatering and caused a general shortage of water before and after sowing. Sowing was completed early, there being no interruption from rains. Hot dry weather continued after sowing, and growth was slow till early September when there was a spell of humid weather. A further spell of hot weather again retarded growth until the arrival of cooler weather in early October, after which growth and development were fairly normal. Nitrogen deficiency symptoms appeared early on poorer land and persisted throughout the season.

Jassids were the only pest to be abnormally severe in 1950/51 season. Bollworms were about average and whitefly less than usual. The latter was practically absent most of the season and consequently leaf curl was late in arriving and much less severe than usual. Blackarm was present, and severe in patches.

Leaf and boll shedding were severe only where associated with jassids and blackarm. The size of plants and severity of jassid damage varied greatly within the Farm area. Yields were generally larger than expected, and all samples of Research Farm cotton which were graded were of high grade.

The 1949/50 Commercial Crop.

Using the 40 Block equation (regression of yield on two rainfall factors) the average yield for the whole Gezira in 1949/50 was estimated at 2.98 kantars per feddan (S.E.=0.30 k.p.f.). The actual yield recorded was 4.58 which differs significantly from the estimate at the P=0.05 level. This has not happened before.

The areas sprayed against jassids (126,031 feds.) and manured (77,451 feds.) in 1949, were far greater than ever before, and constitute a great change in agricultural practise compared with that prevailing during the base period of the calculation. It will be some years before the effects of these new conditions can be properly incorporated into the statistical picture but in the meantime it is interesting to note that by merely adding weighted increases from this extra spraying and manuring (each assessed independently, and separately from this work) to the rainfall estimate, the arbitrarily corrected estimate then becomes 4.28 k.p.f., which is as close as usual to the actual final yield. In this correction the spraying response was taken as 1.7 k.p.f., which had been independently estimated to be the increase that resulted from spraying in 1949.

Arbitrarily corrected estimates, for various different spraying responses, would have been as given in Table I.

TABLE I.

Estimates of Gezira yield arbitrarily corrected for varying effects of jassid spraying.

Correction.	Estimated Yield (Corrected).
Manure + spraying at .5 k.p.f. increase ..	3.60 k.p.f.
,, + ,, at 1 ,, ,, ..	3.90 ,,
,, + ,, at 1.5 ,, ,, ..	4.18 ,,
,, + ,, at 2 ,, ,, ..	4.48 ,,

This supports the probability that the effect of early rains on jassid population is an important factor contributing to the rainfall—yield correlation.

An important feature of the 1949/50 commercial crop was its good grade. Grade and other features of the crop will be discussed later in the report.

OBSERVATION PLOTS.

Old Observation Plot (H. 57). The yield of this plot was 3.38 k.p.f. in 1949/50 season. This is a marked improvement on last year's yield, but is very poor in comparison with the Sudan Plantations Syndicate yield, other Research Farm yields, and the previous yields of plot 57 itself. Plot 57 was sprayed during the 1949/50 season, and suffered less jassid damage than many better yielding plots. Other pests were negligible, although bollworms caused slightly more shedding than usual. Wilt, leafcurl and blackarm were practically absent, and it can be accepted that pests and diseases were not important factors in determining the 1949/50 yield of this plot.

Leaf shedding was normal in 1949/50, but a significant abnormality of the season was the very low number of nodes on the lower sympodia. Bud shedding was high in the early stages. Associated with this, flower number was the lowest on record. Growth, particularly of sympodia, was very slow till the arrival of the cold weather in November. Consequently the crop was late and mostly borne on the upper sympodia. Observations from other plots indicate that short lower sympodia were a general characteristic of the season. Table II gives a comparison. It is to be noted that later growth of sympodia compensated, in part at least, for the poor early growth.

TABLE II.

Plot 57 and Gezira Observation Plots.

(*Sample taken end October, Var. M.S.D. Sakel*)

Observation Plot	Mean Nodes per branch 1949/50	Average up to 1949*
Plot 57	1.26	1.73
G.R.F., G.O.P.	1.43	1.62
Turabi., G.O.P.	1.47	1.55
Hag Abdulla., G.O.P. ..	1.45	1.62
Abu Guta., G.O.P.	1.47	1.47

The poor growth of lower sympodia and the general appearance of the plants were characteristic of manured cotton grown under water-logged conditions, and investigations are being carried out into the possibility of poor soil aeration being the cause of the poor yields of this plot. Work so far indicates that porosity and moisture contents of the soil body are not much different from those of other Farm plots, but that lack of cracks may be responsible for poor aeration.

Gezira Observation Plots. All plots yielded well in 1949/50, those at Turabi and Abdel Magid producing record yields. An interesting feature of both G.O.P. and S.P.S. results is the relatively high yield of Sakel cotton as compared with X 1730 A. Yields of the Research Farm plot were comparatively poorer than the others because of poorer rains and uncontrolled jassids (Turabi and Abdel Magid were sprayed).

Other observation plots. In both the Gash Soil and the Root Excavation Plots, yields were much higher than in 1948/49 and fell in the expected order. Root development was much greater from the second foot downwards, but less in the top foot than in 1948/49 season.

MANURING EXPERIMENTS.

Yields were higher than in the 2 previous seasons except in a few cases where jassid damage was severe.

In the New Organic Manure Experiment a notable feature of the results was the effectiveness of 1949 applications when compared with those of one year earlier. This is not always the case. The explanation may lie in the poor pre-sowing rains preventing a build up of micro-activity and thus leaving mobile such nitrate as the soil contained. Heavy rains in May may have caused some nitrification.

* Averages mainly for 10 years.

No unusual results were obtained in experiments with nitrogenous fertilizers, direct applications of nitrogen always giving marked increases. In the N.P.K. experiment phosphate gave a significant increase but potash did not.

Fallow Hoeing Experiments.

Increases of approximately 1 kantar per feddan resulted from hoeing the 1948 fallows before cotton. In experiments where the 1947 fallows had been hoed no increases resulted from this hoeing. Both these results are remarkably uniform over all fallow hoeing experiments. It will be remembered that hoeing 1947 fallows was of practically no benefit to the 1948/49 cotton crop.

Weed killer trial.

In 1948 a further trial of hormone weed killers on fallow weeds was carried out on Plot 225, and this came into cotton in 1949/50 season. In this experiment early and late applications of Agroxone, Phenoxyl, Chloroxone, and Denocate were compared with early and late hoeing and no weed control. The effect of these treatments on the numbers of weeds is shown in Table III.

Table III.

Effect of Weed Control on Fallow Weeds (1948).

	Number of Weeds per feddan (thousands)								
	Early Application			Late Application			Early plus Late		
	(1) Before	(2) After	(3) After	(1) Before	(2) Before	(3) After	(1) Before	(2) After/ before	3 After
Agroxone	240	119	nd	521	262	80	359	135	39
Phenoxyl	355	158	nd	292	195	79	243	230	39
Chloroxone	320	191	nd	325	269	71	321	158	68
Denocate	241	122	nd	339	308	67	338	161	83
Hand Hoeing	344	71	nd	286	256	74	346	109	86
No Treatment	257	202		255	202	72	255	202	72

(1) 1st sample taken on 23rd August before early and late applications.

(2) 2nd sample taken on 20th September before late applications and after early applications.

(3) 3rd sample taken on 31st October after both early and late applications.

The 2nd and 3rd samples were analysed, in each case covariancing on the numbers in the 1st sample, with the following result:—

2nd. sample.

Differences between treatments were significant

	Corrected No. of Weeds per feddan (thousands).
Agroxone	125
Phenoxyl	193
Choloroxone	169
Denocate	142
Hand Hoeing	78
No Treatment	210
Significance	***

Sig. diff. (P.=0.05) between No Treat. and any Treat.=57
Sig. diff. (P.=0.05) between two treatments=67.

3rd sample.

There were no significant differences between treatments. "Early plus late" applications did not differ significantly from "late only".

It will be noted that weed numbers fall as a result of natural competition as the season advances. This fall is compensated for by the increased size of the remaining weeds. This is clarified in Table IV which shows the dry weight of weeds per feddan for treatments and samples given in Table IV.

TABLE IV.

	Dry Weight of Weeds in Kilos per feddan								
	Early Application			Late Application			Early plus Late		
	(1) Before	(2) After	(3) After	(1) Before	(2) Before	(3) After	(1) Before	(2) After/ Before	(3) After
Agroxone	173	92	nd	345	271	115	197	132	59
Phenoxyl	240	136	nd	285	293	94	144	192	55
Chloroxone	132	134	nd	238	241	141	139	136	131
Denocate	173	131	nd	230	290	79	195	170	152
Hand Hoeing	194	35	nd	212	258	60	238	65	158
No treatment	227	290	118	227	290	118	227	290	118

These figures should be a better measure of "weed effect" than weed numbers, but they are badly upset by the occasional occurrence of single very large weeds in the samples. These occur particularly in the hormone treatments where some types are resistant to treatments. ("Weed cover", and "weed height" are unsatisfactory measures of "weed effect" for the same reasons).

Field observations indicate that, as in similar 1948/49 experiments, hand hoeing and denocate act quickly but have little or no lasting effect. The hormone weed killers on the other hand continue to be effective for some time after application. This was particularly noticeable and important in the season concerned (1948) as there was an excessive amount of late rain which brought up a new crop of weeds after the date of the "late" treatment. These observations are only partially confirmed by statistical analysis of the data.

Tables V and VI show the effect of fallow weed control on weeds in the following season, 1949. The figures are averaged from samples taken before and after sowing cotton.

TABLE V.

Residual effect of type of 1948 *weed control, on* 1949 *weeds.*

(*averaging dates of application*).

	No. of weeds per feddan (thousands)	Weight of weeds Kg/feddan.
Agroxone	115	21
Phenoxyl	105	21
Chloroxone	94	18
Denocate	180	26
Hand Hoeing	123	28
Significance	(N.S.)	—

TABLE VI.

Residual effect of times of 1948 *weed control, on* 1949 *weeds.*

(*averaging types of control*).

	No. of weeds per feddan (thousands)	Weight of weeds Kg/feddan.
Early Application ..	116	18
Late Application ..	163	29
Early and Late Application	91	21
No Application ..	170	29
Significance	**	—
Sig. diff. (P=0.05) ..	47	—

Cotton in treated plots was not affected morphologically by the hormones. Yields following the 1948 treatments are given in Table VII.

TABLE VII.

Effect of types of 1948 *weed control on* 1949/50 *cotton yields.*

(*averaging times*).

	Yield of Seed Cotton (k.p.f.).			
	Early Application	Late Application	Early plus Late Application	Average
Agroxone	5.45	5.01	6.30	5.59
Phenoxyl	5.24	4.91	5.54	5.23
Chloroxone ..	5.09	5.25	6.00	5.45
Denocate ..	5.06	5.09	5.47	5.21
Hand Hoeing ..	5.26	5.43	5.66	5.45
				Significance (N.S.)

Effect of times of 1948 *weed control on* 49/50 *cotton yields.*

(*averaging types*).

	k.p.f.
Early application	5.22
Late application	5.14
Early plus late	5.80
No application	4.87
Significance	***
Sig. diff. (P=0.05)	0.36

There was no significant difference between the different weed killers and hand hoeing. "early plus late" applications are significantly better than either "early" or "late" application. No interaction between type of weed control and time of application was significant. These yields are obviously related to the main differences in weed numbers of both the 1948 and 1949 seasons, and though the degree of significance of the results does not permit it, it is tempting to look for detailed relationships.

WATERING EXPERIMENTS.

An experiment was carried out at the G.R.F. to study the effects of the rainfall between July 1st and 15th August. In this experiment water was applied by sprinkler to simulate rainfall, and in this way bring up to 360 mms. the rainfall between 1st July and 15th August. The same amount of water was applied by furrow irrigation, and both compared with the normal rainfall. The July to 15th August rainfall being very low in 1949, it was an ideal season for the experiment, but unfortunately irregularities in the plot and certain difficulties in the practical application of the treatments made the interpretation of the results difficult. Yields are given in Table VIII.

TABLE VIII.

	Yield of Seed Cotton k.p.f.
Rainfall only	5.59 (100)
Furrow irrigation	6.11 (109)
Sprinkler irrigation	6.60 (118)
S.E.	+0.387

The experiment was done on hoed and unhoed (grazed) plots. Owing to the layout adopted it is not possible to test whether the fact that yields following hoed fallows were greater than those following grazed fallows was statistically significant, nor whether difference between sprinkling and the other treatment was statistically significant. It was possible to test the difference between "rainfall only" and "furrow irrigation" and this was found not to be significant, on either hoed or grazed plots. The data quoted are averages over hoed and grazed plots.

Throughout the season observations on soil moistures, nitrates, weed growth, and plant characters were made, and plant samples for dry matter and nitrogen were taken. Space does not permit of the detailed presentation of these observations.

Apart from the direct effects of sprinkling on soil moisture, nitrates, and weed growth, none of the observations appear to be at all significant. This is possibly partly due to the irregularities mentioned above, as it was recorded that some of the sprinkler samples came from a bad piece of soil. It must be remembered however, that though sprinkling simulates rainfall it does not simulate a high rainfall season, and the "aerial" factors affected by a high rainfall season will be affected practically not at all by sprinkling. One of the most important factors eliminated in this way is the difference in severity of jassid attack. Another is certainly the effect of air and soil temperatures, air humidity, and cloudiness which will extend into the cotton growing season. Weed germination in this experiment shows some evidence of these effects. The germination of weed seeds (measured by weed numbers, as distinct from weed growth, was much the same in each treatment, and less than would be expected in a good rainfall year. It is generally assumed (though proof is lacking) that good presowing rains result in the elimination of weeds before sowing cotton.

Soil moisture content increased in the case of both irrigation treatments, furrow irrigation being highest especially in the 2nd foot. This is no doubt due to the fact that furrow irrigation water had to be put on in heavier single doses, and that it entered the soil mainly via cracks. A fall in moisture content in the 3rd and 4th foots of the sprinkler treatments was almost certainly due to the much more vigorous weed growth on this treatment. Soil nitrates appear to have behaved as expected, being carried downwards most effectively in the

sprinkler treatment. The leaching of nitrates from the ridge tops in this treatment is probably the reason for its continued lower nitrate content in the top 2 feet. Sampling before sowing was not done below the 2nd foot, but sampling down to 6 feet after sowing shows higher nitrates at lower levels in the sprinkler treatment. These observations confirm earlier observations made by the Soil Research and Plant Physiology Sections on nitrate movements in rainy seasons.

Estimation of salt content was not done on soil samples, but salt contents are probably of considerable interest and importance, and should be done in similar future experiments. In the sprinkled treatment growth in the early stages was maintained at the same level as in the others, despite the fact that nitrate content within the zone of the young roots was less. This may be due to a lower salt concentration making nitrate absorption by the plant easier.

Even though differences in distribution of moisture and nitrate appeared to continue into the period of cotton growth, they had no obvious effect on the growth of cotton roots, or on the plant as a whole. Weed effects were more severe at all stages in the sprinkler treatment, and no doubt had a depressing effect on cotton growth in this treatment. A slight improvement in percentage nitrogen, certain growth characters, and fruit shedding, in the later samples of the sprinkled treatment may reflect its higher nitrate percentages at lower levels.

Pest Control Experiments.

As in the previous year pest control observation plots were sited near to the Gezira Observation Plots at the Research Farm, Turabi, and Abu Guta, and treated sub-plots were sprayed at the time the G.O.Ps. were sprayed, or would have been sprayed had spraying been done in the area concerned. The effect of the spraying at each station is shown in Table IX.

Table IX.

Effect of Jassid Spraying with D.D.T.

	Yield of Cotton (k.p.f.)		
	Research Farm	Turabi	Abu Guta
Sprayed	6.33	5.11	6.26
Not Sprayed	5.11	4.37	4.72
Increase from Spraying	1.22	0.74	1.54
Significance	***	**	*
Sig. diff. (P=0.05)	0.39	0.36	1.11

In another spraying experiment at Abu Guta carried out for the Entomological Section, spraying gave an increase of 3.65 k.p.f. (Sig. diff. at P=0.05 0.98). In view of the interactions between spraying and manuring, and other factors affecting the G.O.Ps. it is not possible to estimate a corrected value for G.O.P. yields from these results, but they give an indication of the magnitude of the effect of jassids.

GRADE EXPERIMENTS.

Picking and grading by zones. At the Research Farm 96 X1730A plants in each treatment of the G.O.P. were marked and picked by zones. Samples from each zone and picking were graded by S.P.S. graders. The purpose of the experiment was to find if different parts of the plant bear different grades of cotton. Each zone consisted of 5 main stem nodes and their sympodia, and were designated Zone A, B, C etc. starting from the bottom node. Pickings were done throughout the season at normal (14 day) intervals. Smaller zones or closer pickings would have made the samples impossibly small; as it was, they were too small for the grader to give his best opinion. Close and wide spaced, and manured and not manured plants were compared.

Results are summarised in the diagram. It will be seen that in all cases the upper zones bear a higher proportion of low grade cotton. Late pickings also consist of low grades, and further study of the data shows that it is only because the crop from the upper zones is late that it is mainly low grade. This is made clear when the grades of the zones are plotted separately for each picking and grades for pickings plotted separately for each zone.

Grade Correlations. Correlations between the average grade of Hag Abdulla Block and various observations from the Hag Abdulla Observation Plot were made. There is such a large error in grading a few small samples, that Block grades were considered more reliable than G.O.P. grades, though they do not come from the same sample as the observations. None of the plant characters tried was found to be significantly correlated with grade.

A series of correlations between Hag Abdulla Block grade and meteorological data was investigated. A number of associated correlations were found to be significant. These indicate that spells of high temperatures and low humidity in October, and spells of low temperatures in November, may result in good grades.

The above investigations on grade correlations were of an exploratory nature and further work is required before accepting these correlations at their face value or drawing final conclusions.

Bad Boll Opening. An exploratory pot experiment was carried out to investigate the effects of various treatments on bad boll opening. Pots were treated with nitrate, waterlogging, insulation to prevent fluctuations in temperature, and overhead sprinkling to maintain low evaporation deficit. The last treatment was not satisfactory as it also resulted in waterlogging. Bolls were graded into 3 grades, good, medium and bad opening. Briefly the results were as follows: Compared with no treatment nitrogen reduced the grade of opening 14 percent, waterlogging reduced it 2½ percent, high humidity reduced it 1 per cent, and insulation improved it 3½ per cent of these only the nitrogen effect was significant. The bad opening in the nitrate treatment occurred mainly in the late crop resulting from this treatmeut.

III. Dura.

Establishment, Growth and Yield of 1949 Dura Crop.

Lack of rain before sowing made it impossible to put up old cotton ridges for dura, and sowing had to be done on old ridges. Cracks were particularly large and a certain amount of seed was lost in them. The cracks and the universal dryness caused a shortage of irrigation water and generally conditions for sowing were unsatisfactory and the stand was poor in many plots.

Seedling dura was attacked by grasshoppers, but these were effectively controlled by bait containing Agrocide 7. *Striga* was present in average amount and caused some loss. Aphis and stemborer both caused some damage to the growing crop, and midge damaged late sown plants; other insect pests and diseases were not serious in 1949. In some plots birds were abnormally destructive to ripe heads.

Dura growth improved with the arrival of moister weather in September and continued satisfactorily till harvest time. The crop was noted to have rather small heads, but despite its appearance and its bad start, yields were better than in 1948 and better than average. The only exception to this was the Combined Rotations Experiment where doves from the nearby gardens caused severe damage.

Practically all the experiments reported below are long term experiments so that detailed results are not being submitted here.

ROTATION EXPERIMENTS.

Yields of dura in the main followed the expected pattern in all rotation experiments. Whenever it followed lubia, the dura yield was relatively smaller than usual *e.g.* in the Three Course Experiment and in the Fodder Rotations Experiment.

MANURIAL EXPERIMENTS.

In the Farm Yard Manure and New Organic and Green Manure experiments, dura yields were inconsistent and, as dura follows cotton in both experiments, the previous cotton yield must be taken into consideration. Treatment effects in the Residual Nitrogen Experiment were as expected except for the yield of the 1947/48 application to fallow, which was low relative to that of the other treatments.

FALLOW HOEING EXPERIMENTS.

In the Permanent Fallow Hoeing experiment the hoeing of the 1st (1947) fallow was found to have had no effect, as in the case of similar cotton experiments.

Results of this experiment are shown in Table X :—

TABLE X.

Effect of fallow hoeing on dura yield.

Treatment	Yield of dura (Air dry weight r.p.f.)	
	Heads	Straw
Neither fallow hoed	2,167	4,143
1st fallow not hoed, 2nd fallow hoed.. ..	4,703	6,959
1st fallow hoed, 2nd fallow not hoed ..	2,160	3,823
Both fallows hoed	5,026	7,385
Significance	***	***
Sig. diff. (P=0.05)	577	1,000

In the Fallow Hoeing in Rotations Experiment, hoeing the fallow before cotton in the fallow—cotton—dura rotation decreased the dura yield very slightly but not significantly. The residual effects on dura of watering and hoeing the two fallows before cotton in the rotation fallow—fallow—cotton—fallow—dura gave a surprising result. There were no significant residual effects from watering, but hoeing caused a significant decrease in dura yield as in the three course rotation. These results are shown in Table XI.

TABLE XI.

Residual effect on dura of hoeing pre-cotton fallows in rotation F-F-C-F-D.

Treatment of 1945 and 1946 fallows	Yield of dura in 1949 (Air dry r.p.f.).	
	Heads	Straw
Neither fallow hoed	2,659	5,304
1st hoed, 2nd not hoed	2,270	4,785
1st not hoed, 2nd hoed	1,958	4,053
Both fallows hoed	2,037	4,787
Significance	*	*
Sig. diff. (P=0.05)	504	875

OTHER EXPERIMENTS.

The only other interesting dura yield comes from the Variety Demonstration Plot at Turabi. There Wad Fahl variety gave a yield of 4,704 rotls air dry heads per feddan. This was nearly twice as good as any other variety. Martin Combine also gave a good yield of grain, but as expected, a poor yield of straw.

IV. Lubia and Other Crops.

ESTABLISHMENT, GROWTH, AND YIELD OF 1949/50 LUBIA CROP.

The 1949/50 season was an excellent one for July-sown lubia. The very dry summer was mainly beneficial; there was no water-logging to which this crop is so susceptible; bacterial disease was practically absent; and vegetative growth was continuous and luxurious throughout the season. The only insect pest causing severe damage was the flea beetle (*Luperodes quaternus*), but the attack did not last long and the crop was vigorous enough to withstand it. Thrips and whitefly were negligible during 1949. Some termite damage occurred in most plots. Large yields were harvested in all plots. Almost without exception these were more than twice those of 1948/49 and more than twice the average yield of the plots concerned.

September-sown lubia did not make good early growth. It suffered from *Macrophomina* wilt often associated with termites. It was noted that lubia following dura appeared to suffer more severely from these causes than all other lubia. The flea beetle mentioned above caused some damage in the early stages of growth. When established the crop became fairly free of all pests and diseases, and produced satisfactory yields.

December-sown lubia did not grow satisfactorily or produce good yields. It is probable that warm spells of weather were too few and of too short duration to produce good vegetative growth. The flea beetle did severe damage to this crop. In some plots it was effectively controlled by a 0.4 per cent spray of Agrocide wettable powder.

EXPERIMENTAL YIELDS.

Lubia in Rotation Experiments: Lubia is July-sown in most of the rotation experiments and gave yields of 12,000 to 15,000 rotls fresh fodder per feddan. In the Three Course Rotation the cotton—lubia—fallow rotation gave a yield of 22,801 rotls fodder per feddan. This was the record yield of the season. In the New Rotations Experiment, July-sown, September-sown, and December-sown (after dura) lubia are compared. The results are shown in Table XII.

TABLE XII.

Lubia Yields in New Rotations Experiment.

Rotation	Sowing Date	Yield of Lubia (Fresh weight, r.p.f.)
Fallow—Cotton—Lubia	July	18,920
,, ,, ,, ...	September	12,908
,, ,, Dura/Lubia	December	5,819
		***
Sig. diff. (P=0.05) ..		1,508

In the Fodder Rotations Experiment lubia following dura gave the poorest yields. Table XIII shows the yields in this experiment since its start.

TABLE XIII.

Fodder Rotations Experiment.

Rotation	Date of Sowing.	Yield of Lubia (Fresh weight r.p.f.)				
		46/47	47/48	48/49	49/50	Mean
Continuous Lubia	July	4,040	3,803	2,563	9,854	5,065
Dura—L.	,,	3,902	4,566	1,184	9,162	4,704
Fallow—D—L.	,,	4,024	3,595	1,000	4,131	3,188
F—L	,,	4,916	4,016	2,031	11,347	5,578
D—F—L	,,	4,284	3,543	2,343	11,561	5,433
Continuous D/L.	December	4,706	2,740	2,461	1,396	2,826
F—D/L.	,,	5,739	2,778	3,782	2,084	3,596
					***	
Sig. diff. (P=0.05)					2,765	
Average		4,516	3,577	2,195	7,076	4,341

Waterlogging did not cause any damage in the 1949/50 season, and the poor growth and stand in the rotations concerned appeared to be associated with *Macrophomina* wilt and termites. Further observations are needed before offering an explanation of the depressing effect of dura stubble on lubia yield.

Other Yields. Yields of lubia in other experiments were all between 10,000 and 20,000 rotls fodder per feddan. As in previous years application of phosphate to cotton appears to have had a slight beneficial residual effect on the following lubia crop.

Other Crops.

During 1949/50 observations on fodder crops other than lubia were continued. The object of this work is to increase fodder production within the framework of the present Gezira rotation, and using available water. It is desirable that crops for this purpose should be soil improvers rather than depletors, and that, if possible, they should be established on rain and compete with, or be substituted for, the natural fallow flora. The most acute shortage of animal feed occurs in May and June, but as no water is available then the only possibility would appear to be to grow fodder crops much earlier in the season and store them. There is no water available for winter fodder crops, and in any case none of the winter fodder crops tried have been very successful. Possibilities are therefore limited to crops which can be grown with the minimum possible water in the early part of the season. Though the main need is for a storable fodder, there is a place for grazing crops, specially if they can be substituted for fallow weeds or can free other fodders for storage.

Experiments in the past have shown that lubia produced a greater bulk of fodder than any other crop tried at that time. It is likely that well grown lubia would also out yield most of the crops tried recently. New crops therefore are not likely to be substitutes for it, unless the lack of winter water, and consequent need to sow it earlier make this crop unsuccessful.

All the fodder crops tried (past and present) at the Research Farm were reviewed and it is noteworthy that the number of crops which have been even partly successful is much smaller than those which have failed. A few of the partly successful species are too small for Gezira requirements, being suitable for closed swards rather than the ridge cultivation which Gezira soil conditions necessitate.

During 1949/50 several observation plots were laid down to obtain information on the establishment of a number of fodder crops under rain and irrigation, and their regenerative capacity following grazing or cutting. The extreme dryness of the season gave a severe and unfair test of establishment under rain, and no crop produced luxuriant growth without the aid of irrigation water. A number did grow despite the drought, but under field conditions these would have been eaten off immediately by hungry herds. To establish a visible stand of any fodder crop controlled grazing is necessary but, after establishment, there is no data as to whether constant or rotational grazing is the more productive or more suitable for Gezira conditions.

A number of mixtures were tried under rain and irrigation to see which crops were compatible, and suitable for either grazing or cutting.

One of the most successful crops tried is phillepesara (*Phaseolus trilobus*), an Indian fodder crop. Its water requirements are low. Its best growth takes place during the summer *i.e.*, from July till October, when it produces a thick cover. After grazing it regenerates this cover rapidly from stools or seeds. Alone it is not erect enough for mechanical cutting, but it grows well in mixtures with erect plants; mixtures such as Sudan grass and phillepesara, or pigeon pea and phillepesara are promising. Phillepesara also grows under dura without interfering to any extent with the dura crop, and provides a little additional fodder after the dura harvest. Past and present experience indicate that very few crops can be grown with dura without interfering with it. One of the most promising features of phillepesara is its vigour as a rain crop and it offers distinct possibilities as a competitor or substitute for fallow weeds. It is very palatable, and controlled grazing would be a necessary concomitant to growing phillepesara.

Cluster bean (*Cyamopsis psoraloides*) offers similar possibilities to those of phillepesara, but does not have the same powers of regeneration. It is more erect and might be suitable for cutting. This crop is widely used in India.

The Kordofan pea (*Clitoria ternata*) has grown well under Gezira conditions, producing a dense cover of fodder. It is palatable but its feeding value is unknown. *Phaseolus lathyroides*, *Centrosema plumerii* and some varieties of velvet bean have shown promise in small plots and offer possibilities either alone or in mixtures.

Mechanical cutting of lubia is considered to be an important step in conserving fodder, the argument being that, if cut and baled mechanically, the tenantry have a much greater incentive to store their fodder instead of grazing or selling it piecemeal. In 1949/50 the possibility of using a support crop for lubia was investigated. Sunn hemp, Sudan grass, pigeon pea, and cluster bean were tried. Growth of lubia was very vigorous in 1949 and sunn hemp was the only crop which grew rapidly enough and strongly enough to support it. An excellent mixture was produced and the lubia vines were lifted off the ground. Unfortunately no machine was available to carry out practical mowing trials.

Mixtures of other creeping and support crops were tried but except for those already mentioned none was outstanding. Mixtures including cowpeas were reasonably successful and it may be possible to find more suitable varieties than those tried.

Sunn hemp was severely damaged by caterpillars of *Utetheisa pulchella* and this may be a factor limiting the growth of this crop.

Other species of *Crotalaria* tried in 1949 grew vigorously on Gash soil, but practically failed on Gezira soil.

V. Farm Manager's Report.

by M. C. Hattersley.

Farm Areas.

In September 1949 when the majority of the crops were growing, areas were approximately as follows:—

	1948/49	1949/50	
Cotton	261	196	Feddans.
Dura	100	136	,,
Lubia	84	114	,,
Miscellaneous crops ..	67	37	,,
Fruit gardens	—	5	,,
Berseem	37	30	,,
Forests	12	12	,,
Fallows	391	452	,,
Offices, stores, houses and gardens	67	67	,,
	1,019	1,049	

The increase in total area is due to an additional 30 feddans being put under cultivation on the east side of Barakat III canal.

Cultivations.

Cultivations for all main crop areas coming under crop in 1950/51 season were completed by April 15th 1950. No deep ploughing was done, but a new Ford-Ransome mounted plough was used with the Fordson Major tractor on a few very weedy plots; this implement gets down to a good 8 inches in G.R.F. soil.

A considerable number of main crop plots were ridged by tractor and the standard of this work is improving. The cultivations for 1950/51 appeared to be more easily accomplished than is usual as the ground was readily friable.

Disposal of Crop Residues, Weeding and Cleaning.

The pulling out of the 1948/49 cotton, debris sweeping and burning, was accomplished by the official date May 31st. Considerable difficulty was encountered in the debris clearance owing to high winds. The rather unusual distribution of the 1949 rainfall led to the germination and dying off of weeds and considerably lessened the amount of weeding. Main crop cotton and dura areas were all sown clean.

Crops and Yields.

Cotton.

Main crop areas were sown between the 20th and 25th August, somewhat later than usual. Germination was excellent but early growth was very slow and it was not until after mid-September that the crop made much progress. No particular damage was caused by any single pest or disease, with the exception of jassids which were more numerous than usual; in spite of this excellent yields were obtained, as shown in the following table.

Plot No.	Variety	Rotation	k.p.f.
209	X1730A	DLFC	6.95
210	,,	DLFC	6.03
211	,,	DLFC	5.98
214	,,	DLFC	6.88
215	,,	DLFC	6.60
216	,,	DLFC	5.89
226	,,	CFFC	4.22
227	,,	CFFC	5.46
229	,,	CFFC	5.00
231	,,	CFFC	5.38
232	,,	CFFC	5.30
60	,,	LFC	4.11
104	,,	LFC	3.21
230	M.S.D Sakel	CFFC	5.28

Dura.

Main crop dura areas were sown during the latter half of July and germinated fairly well but early growth was very poor and, as in the case of cotton, little real progress was made until after mid-September. A good crop was eventually harvested. All seed was treated with copper carbonate and no smut occurred. The variety used throughout was Feterita 1931.

Yields of Different Rotations.

Plot No.	Rotation	Grain (r.p.f.)
201	FFCFD	1,670
202	,,	1,560
203	,,	1,720
204	,,	1,510
206	,,	1,350
207	,,	1,350
208	,,	1,560
74	DLD	890
75	DLD	960
76	DLD	1,080

Yields of Nitrogen and Pre-Watering Treatments.

Plot No.	Treatment	Grain (r.p.f.)
63	Dura after cotton+84 rotls N. per fed.	1,450
72	,, ,, ,, +84 ,, N. ,, ,, ...	2,100
73	,, ,, ,, +84 ,, N. ,, ,, ...	1,730
	Nitrogen applied as ammonium sulphate.	
302	Dura after rain-dura +105 rotls N. per fed. ..	1,010
305	,, ,, ,, ,, +105 ,, N. ,, ,, ..	1,210
	Nitrogen applied as ammonium nitrate.	
66	Dura after wheat and legumes. Prewatered April	1,730
64	Rotation FCLFD ,, ,,	2,570

It should be noted that these yields are not the results of replicated experiments, but can only be regarded as main crop trials.

LUBIA.

July-sown lubia produced a good crop and only a little bacterial disease occurred. An attempt was made to assess the value of early as against late cuttings. The plot used gave vigorous growth and the crop did not suffer from the leaf shedding that usually takes place on July-sown lubia. This lubia after 12 fortnightly irrigations yielded as follows in rotls fresh weight per feddan.

	1st Cut after 100 days	1st Cut after 145 days
1st cut 9″ above ground level	13,020	17,040
2nd cut after 210 days down to ground level	5,860	7,600
Weight of seed (unthreshed) collected before final cut	740	128

In the new extension, lubia sown in September after dura in the previous season again suffered badly from termites and *Macrophomina*; there seems to be some doubt as to which is the primary cause but fairly large areas were killed off and resowings were unsuccessful and the whole crop appeared to be depressed until early December when it made a remarkable recovery and gave some good yields in spite of the poor stand. Yields were as follows:—

Plot No.	r.p.f. Fresh weight	Averages	
249	12,090		
250	13,330	1946/47	16,700 r.p.f.
251	17,050	1947/48	10,875
252	12,860	1948/49	9,710
253	10,700	1949/50	12,770
254	10,570		
255	Grazed in situ produced 635 r.p.f. threshed seed		
256	Grazed ,, ,, ,, 668 ,, ,, ,,		

All possible lubia is baled and stored for fodder.

BERSEEM.

Plot 108 sown 7.1.49 with a seed rate of 12 r.p.f. yielded 20,720 rotls fresh weight per feddan in 12 months; this is not a good first year yield. It was generally a poor season for berseem mainly on account of insect attack.

CATTLE.

Report for 1949.

STUD BULLS.

"Atebrin" sired 8 female and 8 male calves born during 1949. He remains active and in good health.

"Cyprus" sired 5 male calves born during 1949, and has so far 6 male and 3 female calves entered in the herd book. His progeny do not conform to the standard of "Atebrin" as far as can be judged to date, but we require a stud animal with no "A" family blood in it and "Cyprus" is the only possible home bred source for this. He has been put into tillage and will only be used sparingly in the future.

'Oscar" (born 9.2.47, Sire: "Atebrin", Dam: "Om Rish"— holder of maximum milk yield record) has been used as an alternative to "Cyprus" with "Atebrin's" daughters. He is a fairly large animal of somewhat lighter build than either of the other two.

FEEDING.

The figures in the table below closely approach those of previous seasons. The totals quoted are taken from innumerable small daily weighings, and estimations of grazing. The fact that a fairly even figure has been obtained for daily dry matter consumed per 100 lbs. body weight over a period of 4 years, indicates that we are learning something of the total requirements of the animals. It must again be emphasized that these figures are not precise experimental results.

Total issues air dry matter to herd over Period 1946/49 (*lbs*).

	1946	1947	1948	1949
Dura grain	90,520	72,000	104,028	101,880
Cake	86,060	83,930	50,710	36,350
Gassab (Dura stalk)	226,930	211,200	383,726	318,628
Lubia hay	132,680	116,090	48,970	114,636
Extras (calculated)	61,060	77,810	47,110	55,675
	597,250	561,030	634,544	627,169
Av. Herd weight during year	77,000	80,000	82,000	79,000
Known dry matter issued per 100 lbs. body weight daily	2.2	1.9	2.12	2.17

CALVES AND REARING.

During 1948 calves were reared on 90 gallons of whole milk up to 3 months of age. The system was modified slightly in 1949 when only 70 gallons of whole milk was allowed; the balance being made up of skim milk.

The following table indicates the growth rate of the calves and the variation in birth weight in 1949. Weights are given in pounds.

	MALES				FEMALES			
		6	12	24		6	12	24
No.	Birth Wt.	weeks	weeks	weeks	Birth Wt	weeks	weeks	weeks
1	48	104	161	271	50	106	143	230
2	49	108	150	231	37	93	138	220
3	69	126	176	242	46	100	148	220
4	48	92	136	200	51	106	146	220
5	40	108	151	242	52	111	142	226
6	50	108	133	227	43	100	140	224
7	51	112	150	262	40	82	120	185
8	50	113	170	262	51	106	135	224
9	47	100	150	220	54	99	171	243
10					47	95	132	253
11					45	88	143	224
12					41	88	131	193
Av.	50.2	108.2	153.0	239.7	46.4	97.8	140.7	221.8

Male calves tend to be born slightly heavier than females and maintain this initial difference.

MILK YIELDS.

	Length of lacation (days)	Yield (lbs.)	Average lbs. per day.
Average for 1949 ..	260	3,748	14.3
1948 ..	221	3,414	15.4
1947 ..	180	2,950	16.8

A note has been prepared on, "The Origin and Present Status of the Herd of Kenana cattle at the Gezira Research Farm".

BOTANY AND PLANT PATHOLOGY SECTION

A. Economic Botany.

By F. W. Andrews and K. Wilson Jones.

CONTROL OF SEID GRASS EXPERIMENT.

Numbers 5 and 7 Heleiwa in Abdel Hakam block were used for special deep ploughing against seid grass (*Cyperus rotundus*, L.) ; ploughing was carried out on 20.4.49 using a John Deere disc plough with six 32 inch discs. Four treatments were originally planned as follows :-

Treatment	A	B	C	D
April 1949	DP	DP	DP	DP
August ,, ...	SP	SP	—	—
Sept. ,, ...	SP	—	SP	—
August 1950	—All sown cotton—			

DP=Deep ploughing SP=Shallow ploughing.

The object of the shallow ploughing in 1949 was to destroy any plants remaining after the deep ploughing treatments, by cutting off the plants below the basal bulbs. A Krause disc was considered adequate for this purpose, but on account of light rains and a very poor regrowth of seid, hand work was later substituted. The treatments were distributed at random over 14 fields so that the mean infestation was approximately the same for all treatments.

After deep ploughing, pits were dug at random over the ploughed areas, to ascertain the depths attained by the implements. These averaged 13.5" in 5 Heleiwa and 14" in 7 Heleiwa, and were considered satisfactory.

On 17th-18th August 1949, before the shallow ploughing treatments, pits were dug at various points over the area. Each pit was 1 metre square and the soil was removed in 3" layers to a depth of 3" below the lowest tubers. The tubers were then washed from the soil of each pit and counted ; the obviously bad tubers were rejected, and germination tests carried out on the remainder. Results for the total of 20 pits were as follows :—

Total tubers	3,374
"Bad" tubers	2,712
"Good" tubers	662
Viable tubers	147
Percentage of tubers viable ..	4.4

The percentage of tubers viable varied from 0.3 to 15.6. It will be apparent that most of the tubers were dead at the time of digging the holes, but that results vary. It was also noted in connection with this that on mapping the results of a survey of above-ground regrowth of the tubers, such regeneration of weed as occurred showed up in long strips, parallel with the direction of the original ploughing. It thus appears that the unsatisfactory kill obtained in a few cases may be attributed to poor ploughing rather than anything else. The aerial infestation of seid was so reduced as to provide a striking contrast with surrounding unploughed land. The subsidiary shallow-ploughing treatments were duly carried out, but their assessment must await the 1950 rains.

Control of Water Weeds.

In view of the lack of agreement between the 1947/48 and 1948/49 results using chemicals of the chlorinated phenoxyacetic acid type, and the suggestion that the key to the successful earlier treatment lay in the powder formulation then used, it was determined to test the effect of powder applications of "Fernoxone" (Sodium 2 : 4 dichlorophenoxyacetate) and "Methoxone" (Sodium 2-methyl, 4-chlorophenoxyacetate). The latter was supplied as a 5 per cent dusting powder using a calcium carbonate base, ready for use, and the former, for purposes of comparison, was made up with silt and powdered slaked lime into a 5 per cent powder, to the following formula:—

Fernoxone powder (80 per cent 2-4 : D.) ..	5 kilos
Powdered lime	8 „
River silt	67 „
Total	80 kilos

All the twelve experimental canals at Darwish were sown with the water weeds *Potamogeton nodosus*, *P. perfoliatus* and *Najus pectinatus*, the ones of commonest occurrence in the Gezira, and these were allowed to grow until conditions equivalent to water-block in irrigation canals had been attained. Treatments were allotted to the canals as follows and replicated four times

(1) Control—no treatment.

(2) Fernoxone preparation to give 10 p.p.m. active agent in canal water.

(3) Methoxone preparation to give 10 p.p.m. active agent in canal water.

All the experimental canals were cut off from the supply channel at the time of treatment, but 3" diameter pipes were fitted and opened after the first two weeks in order to keep the canals filled with water.

After one week, weeds were observed to be going brown in the treated canals, and after two weeks, most of the weeds either were floating, flaccid fragments, or had sunk to the bottom. At the end of the third week the only living weeds in the treated canals consisted of detached and moribund fragments. In many instances the seid grass at the water's edge showed signs of damage. After four weeks no floating weeds could be detected, and the canal bottoms consisted of fine black mud derived from their decomposition.

Treatment was carried out on 1.5.49. At intervals, water samples drawn from the treated canals and from the controls were tested for residual effect by being used to water pots of dura seeds under standard conditions. This test is sensitive to less than 0.5 parts per million of the chemicals used. On 9.5.49 (8 days) and 14.5.49 (13 days) the test showed that much of the material was still present in the water. A third sampling, on 21.5.49 (20 days) gave much the same result. By the 28th May (27 days), much of the effect was lost, and one of the "treated" pots was indistinguishable from the controls. In general, the Methoxone-treated water allowed better growth than the Chloroxone-treated water. Slight effects however, continued to be apparent until June 25th (55 days), when no difference in growth could be detected.

All treated canals remained clear of floating weeds until 24.9.49, when leaves and stems of *P. nodosus* appeared in the pipe at the head of one of the Fernoxone-treated canals; probably originating from fragments of this weed carried in as a result of hand-weeding operations in the supply channel. As it formed only a single example, it was removed weekly so as to prevent seeding or vegetative spreading, and precautions were taken against the further entry of portions of weed into the experimental canals from the same source. With this single exception, no floating weeds appeared in any of the treated canals during the entire cotton season, though the conditions of ponding, as exemplified by the control canals, were ideal for their growth.

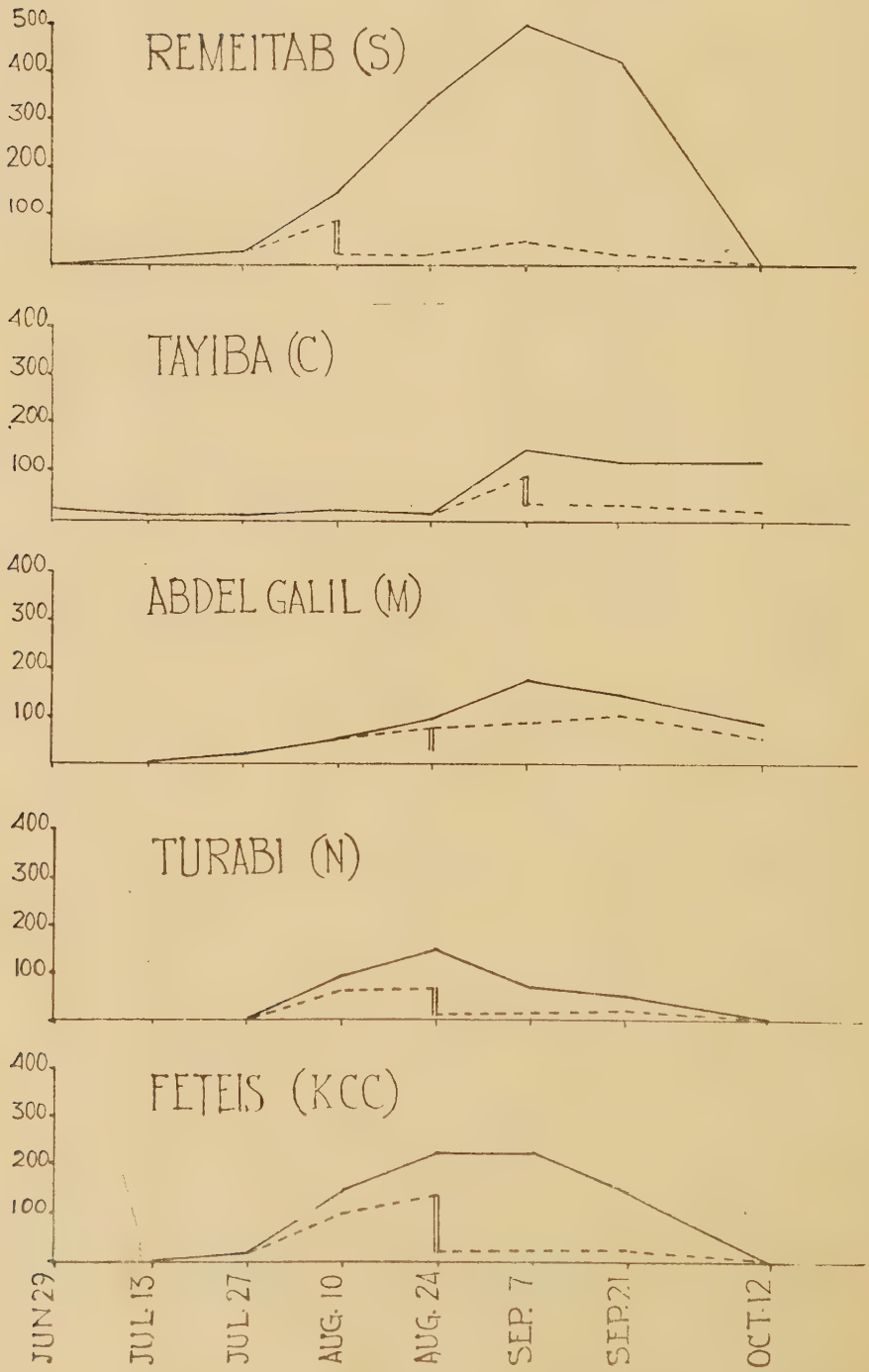
As the Fernoxone treated canals all contained lime, resulting from the attempt to standardise the conditions of application of the weed killers, it was decided to sacrifice one of the control canals and to treat it with a straight mixture of Fernoxone and river silt, giving a 5 per cent 2-4 : D dust without the addition of lime. Treatment was carried out on 6.10.49. Most of the floating weeds were brown ond dying by 29.10.49 (23 days), though not until 27.11.49 had all floating weeds completely disappeared. The lower temperatures holding during the treatment period were believed responsible for the slower kill. This canal also remained free of weeds throughout the 1949-50 cotton season.

Weed Observations on S.P.S. and K.C.C. Long-Term Fallow Hoeing Experiment.

In each number under observation, Field A was included so as to give four controls and so balance the numbers of control and treated fields. The size of the quadrant square was reduced to 50 cms. by 50 cms. to allow a larger number of squares to be observed (six per field). Finally, observations were increased to fortnightly intervals, giving a total of eight observations during the rains, on every plot. In each of five blocks, four fallow numbers were considered, each consisting of eight fields (four treated, four controls) on each of which six 50 x 50 cms. squares were observed by uprooting of the plants and counting. Squares were naturally taken in different parts of each field on each occasion of observation. The results, being given as number of plants per square metre of land, can be expressed as graphs showing the rise and fall of both individual weeds and total weeds, for each treatment. By studying these results on fallows following fallow, cotton, and lubia it is possible to assess the residual effect (at any rate up to the commencement of 1949 weeding) of previous weedings on the weed population. Graph I shows a typical after-fallow effect at the five sites.

See p. 56.

GRAPH 1
MEAN WEEDS PER SQUARE METRE AFTER WEEDED AND UNWEEDED FALLOW



Weeds were found to be reduced in numbers per sq. metre on all areas as a result of previous weedings. On numbers weeded in the preceding year (1948) this is not surprising, but the same effect was also found on fallows weeded in 1947, which had borne a crop of cotton in 1948, and on fallows weeded in 1946, which bore dura in 1947 and lubia in 1948. The residual effect of the 1946 weeding actually seemed greater than that of the 1947 weeding, and it is possible that this is due to the fact that 1946 was a year of good, and 1947 a year of poor rains. The difference between weeded and unweeded fields would be greater in a year of good rains than in a year of poor rains, and it is noteworthy that increase in cotton yields as a result of fallow weeding were higher after 1946 weeding than after 1947 weeding.

Further examples of damage by soil blown from weeded fields on to young cotton were reported, as happened last season. An interesting point is that ploughed land does not give rise to this effect, suggesting that the root of the trouble may lie in the implements used. It becomes, however, steadily more evident that if fallow weeding is to be adopted, the attendant risks of soil blowing and of the spread of perennial and cultivation-resistant plants must be faced. *Sonchus cornutus*, mentioned in the 1948/49 report as spreading, does not appear from the present results to be spreading as fast as was then feared, animal grazing probably keeping down the infestation. Other weeds, however, such as *Euphorbia acalyphoides*, are unpalatable, and there seems little doubt that in reducing the numbers of easily killed weeds the way is being opened to the spread of pernicious ones. In considering smother crops the present mid-season stand of *Phyllanthus niruri* over most of the Gezira must be considered fairly near the ideal, in that (a) it is capable of depressing the numbers of other weeds, and (b) it is itself fairly easy to remove by simple hoeing.

A possible compromise suggests itself, in the form of the weeding only those fallows immediately preceding the cotton crop, leaving the rest available for grazing and cover.

Individual weeds were found to vary in their response to fallow weeding. Thus for instance *Leucas urticaefolia* was heavily reduced, whereas *Cyperus rotundus* and *Ipomoea* spp. were scarcely affected. It was also found that some weeds vary in their response to preceding crops, *Leucas urticaefolia* showing its poorest development after lubia and its best after unweeded fallow. This may of course be bound up with the fact that the plant is highly intolerant of weeding.

Observations on Methoxone and Chloroxone as Growth Promoters.

As a result of the experiment of 1948/49, in which it appeared that treatment with extremely small quantities of Methoxone and Chloroxone (or Fernoxone) brought about a slightly increased yield of early-picked and presumably better grade cotton, it was decided to test the effect again in 1949/50.

Treatments consisted of spraying with 100 gallons per feddan of 0.05, 0.10 and 0.20 parts per million solutions of the two chemicals, applied either the day before sowing, or at thinning time, three weeks after sowing, as follows:—

Strengths		Chemicals	Times
Control		Methoxone	Before sowing
0.05	ppm	Chloroxone	After thinning
0.10	,,		
0.20	,,		

5 replicates

Sowing date: 15.8.49; spraying dates 14.8.49 and September 5th. Spraying was carried out using knapsack sprayers and every attempt was made to secure even distribution of the material over the land or plants as was required. A moderately severe blackarm attack developed towards the end of the rainy season, mainly in the northern end of the plot, and jassid attack was heavy throughout.

Differences in early yield and final yield between treatments were slight and not significant.

B. Plant Pathology.

By S. A. J. Tarr.

I. Plant Diseases in the Gezira.

1. Blackarm on Cotton (*Gossypium barbadense* L.).

Causal organism (*Xanthomonas malvacearum* (E.F.S.) Dows.

In general the incidence of this disease in Gezira cotton was light but a few small areas of heavy infection occurred in the southern and central Gezira. It can have been responsible for little loss of crop. Certain varieties grown in the Plant Breeding Plot at Hag Abdalla were found to be quite heavily infected in early October and from observations made at that time it appeared that seed borne infection might well have been responsible. The sowing seed for these varieties came from experimental plots at the G.R.F. and Kassala which suffered heavy blackarm attack in the previous season and, although the seed had been disinfected, it is probable that a slight amount of infection persisted. It is likely that, with heavily infected seed, a very small proportion of internal seed infection may occur and this would not be destroyed by the methods of seed treatment employed.

A survey of the Gash Delta cotton areas in late 1948 had indicated that blackarm infection was very light. It is probable therefore that —apart from possible "ginnery infection"—the sowing seed for the 1949/50 Gezira crop carried very little blackarm infection, especially so after disinfection with Abavit B. This would not be entirely the case with the Barakat Seed Farm where some of the sowing seed used is of Gezira origin.

Observations on certain 1949/50 cotton areas at the Barakat Seed Farm suggested that very little seed-borne blackarm infection was present. The sowing seed had been disinfected with extra strong Abavit B (8.5 per cent mercury content) in an effort to reduce infection to as low a figure as possible. Later observations indicated that in many cases blackarm in the new crop could be traced to adjacent fallows which had carried a cotton crop in the 1948/49 season.

2. Leaf Curl of Cotton.

Caused by the cotton leaf curl virus (=*Gossypium* virus 1. Farquharson).

This disease was remarkably light in incidence this year, both in the Gezira and at the G.R.F. Although present in the Sakel cotton it spread but slightly in comparison with previous seasons and can have caused no appreciable loss of crop. The reason for this extreme lightness of attack is not known but possibly it is to be associated with whitefly incidence which was low this season.

3. Leaf curl of other Malvaceae.

During July and August 1949 observations made in the Wad Medani area indicated that considerable illegal out-of-season cultivation of bamia (*Hibiscus esculentus* L.) was taking place in riverain cultivations and irrigated gardens. In many cases the plants showed leaf curl symptoms. Such cultivations constitute a means of seasonal carry-over of the disease and are a very real danger to Gezira Sakel cotton, especially if the latter is near the cultivations.

4. Fungi on Cotton.

Fungal Wilt (various fungi), boll rot (various causes) and sooty mould (*Cladosporium* spp., *Alternaria* spp.) were all observed on Gezira cotton but none was responsible for serious damage.

5. Covered smut of Dura (*Sorghum vulgare* Pers.)

Caused by *Sphacelotheca sorghi* (Link.) Clint. This was rarely found in places where copper carbonate treated seed had been sown. In places where untreated seed had been sown, and especially so with rain-grown dura, numerous smutted heads were to be found and the disease must have caused considerable loss of grain.

6. Bacterial Blight of Lubia.

Causal organism: *Xanthomonas phaseoli* (E.F.S.) Dows.

This was widespread on early sown rain-grown lubia and was severe in places where heavy rains encouraged its spread. Late sown lubia suffered little damage.

7. Leaf Curl of Tomato.

This unidentified virus disease was observed in gardens but did not appear to be as widespread as in most years.

8. Mildews.

As usual these were to be found on many vegetables especially bamia, cucurbits and other plants. *Leveillula taurica* (Lev.) Arn. and *Sphaerotheca fuliginea* (Schlecht.) Poll. were perhaps the most widespread. None was found on cotton in the Gezira but the finding of a powdery mildew on native grown American cotton at Busata (see page 50) indicates that it may well be only a matter of time before one or more of the mildews so prevalent in the Gezira extends its host range to include cotton.

II. Plant Diseases at the Gezira Research Farm.

1. Blackarm on Cotton.

Although blackarm was present in most cotton plots at the G.R.F. it became severe in only a few and in most it eventually dried out without having been responsible for heavy damage. The first observed appearance was in Plot 2 on 17th September as compared with 31st August 1948, (Plot 261 : seed infection due to imperfectly Abavited seed), 8th September 1947 (Plot 4), 1st September 1946 (Plots 2, 3, 4) and 22nd September 1945 (Plot 3). The early appearance of blackarm in Plots 1—4 each season may perhaps be associated with the fact that the whole of Plot 4 is sown with Sakel cotton each year; the volunteer cotton seedlings which come up when the plot is irrigated are closely surrounded by the newly sown cotton and any blackarm infection they may be carrying will tend to spread to the latter without difficulty. Blackarm was severe in Plot 228 (Plant Breeding Plot) and appeared to be especially so in the sub-plots of two varieties— JR 1530 and RDS. Both varieties were sown with seed from plots which suffered heavy blackarm attack in the 1948/49 season. Spread to other varieties in the plot took place.

The annual estimate of blackarm severity in certain standard G.R.F. plots carried out in late October 1949 indicated that the disease was considerably lighter than in 1948/49 but slightly heavier than in 1947/48.

The farm clean-up 1949. In view of the severe blackarm in some G.R.F. plots during the 1948/49 season a thorough inspection and clean-up of the G.R.F. was carried out in July and August, in addition to the normal clean-up earlier in the year. Fair numbers of volunteer cotton seedlings were found and destroyed but only occasional ones showed blackarm symptoms. Cotton ratoon growth appeared to be heavier than in the previous season and considerable numbers of ratoons were destroyed. A few sprouting cotton stumps from the 1947/48 season were found which had survived two dry seasons and were still alive. Almost all the ratoons found were X1730A : none showed leaf curl symptoms.

2. Leaf Curl of Cotton.

This disease was remarkably light on cotton at the G.R.F. in the 1949/50 season. It was first observed in Plot 1 on 5th November 1949 as compared with 9th November 1948, 1st November 1947 and

8th October 1946 and 1945. Thereafter it was found in other Sakel plots but did not spread so quickly or so extensively as in previous seasons. The annual inspection of certain G.R.F. plots carried out in the second week of March gave percentage infection figures varying from nil to about 2 per cent with the highest infection (11.8 per cent) in Plot 1. In March 1949 infection ranged from about 20—65 per cent, most Sakel plots showing about 50 per cent infection. Figures for March 1948 were even higher.

3. Leaf curl on other malvaceae.

In late 1949 bamia growing in G.R.F. gardens showed leaf curl symptoms but the attack was not severe. No leaf curl symptoms were seen on malvaceous plants other than cotton and bamia this season at the G.R.F.

4. Other diseases of cotton.

Small patches of wilt (some of it of fungal origin) were noted in several plots but caused little damage. Occasional cases of boll rot and sooty mould were observed later in the season.

5. Diseases of dura.

All dura sowing seed was treated with copper carbonate and only rare cases of smut were found.Anthracnose (*Colletotrichum graminicola* (Ces.) Wils) was observed on young dura but caused negligible damage.

6. Diseases of lubia.

Bacterial blight was first reported on 20th. August on early sown (July) lubia—at about the same date as in 1948 and 1947. Although it resulted in some leaf drying and shedding it was not usually severe except in small patches. The later sown lubia suffered only a mild attack.

Macrophomina wilt (associated with *M. phaseoli* (Maubl.) Ashby) was not uncommon in some lubia plots and was responsible for slight damage. This wilt was also found on fasulia (*Phaseolus vulgaris* L.) in G.R.F. gardens.

7. Mildews.

These were widespread, mainly on vegetables and cucurbits.

III. Plant Diseases in Other Parts of the Sudan.

1. The Gash Delta.

In the first half of September 1949 a survey of possible means of leaf curl seasonal carry-over was made. Sakel cotton ratoons were rather more numerous than in 1948 but much less so than in 1947. The pulling out of Sakel plants after the final picking was probably as least as thorough in 1949 as in 1948 : the rather more profuse ratoon growth in 1949 being attributable to more favourable climatic conditions

(especially rainfall). Less than 20 percent of the Sakel ratoons showed leaf curl symptoms except in the one early-sown Sakel area of 1948/49. The latter had been exceptionally well cleaned and only a very few ratoons were found, of which about 75 percent were leaf curl infected. In the X1730A area, very heavy ratoon growth was noted, as would be expected since this cotton is cut out instead of being pulled. Of the several thousands examined only ten showing leaf curl symptoms were found : an indication of the extremely high leaf curl resistance of this cotton when grown in the Gash Delta.

A survey of blackarm and leaf curl diseases in the Gash Delta cotton crop was carried out in November—December 1949. Blackarm was found to be extremely light in incidence, even more so than in the previous season. This may perhaps be associated with the lightness of this disease in the Barakat Seed Farm 1948/49 crop from which the sowing seed for the 1949/50 Gash cotton crop was drawn. The seed from the latter must have also been remarkably free from blackarm infection *i.e.* the sowing seed for the 1950/51 Gezira crop will also be clean, except for any blackarm infection it may pick up after leaving the Gash Delta.

Leaf curl was also lighter than usual. In the late-sown Sakel cotton it was very light indeed whilst, in the only two early sown Sakel areas, the disease, although widespread and heavy in patches, was less severe than in previous years. There is little doubt that early-sown Sakel in the Gash Delta often tends to suffer severely from leaf curl disease but late-sown Sakel suffers only slightly. This finding is being utilised in that as much as possible of the Gash Sakel crop is grown on second rotation (late-sown) misgas. It was noted that whitefly, the vector of leaf curl disease, was unusually light in the Gash during the 1949/50 season, and this may well have been partially responsible for the comparatively light leaf curl attack experienced.

2. The Busata Pump Scheme.

An investigation concerned primarily with a heavy outbreak of blackarm disease in the cotton grown on this pump scheme was carried out in the second half of January 1950. Since this was the first season of cultivation it was of importance to determine the origins of this outbreak. It was considered that infected seed cotton and bolls might have been brought into villages on the scheme from elsewhere for local domestic spinning, and that introduction and dissemination of the disease may well have occurred in this way.

Whilst visiting Busata the writer noticed a number of native grown American-type (*Gossypium hirsutum* L.) cotton plants the leaves of which were infected with powdery mildew. The latter has not previously been recorded on cotton in the Sudan. Only the conidial stage of the mildew was present and the conidia showed considerable variation in size and other characteristics, conforming most nearly to *Sphaerotheca fuliginea* (Schlecht.) Poll. This is, however, only a very tentative determination and until further specimens or the perfect stage can be examined the fungus can best be described as *Oidium* sp. This first discovery of powdery mildew on cotton is disturbing in that it raises the possibility that such mildews, very prevalent in the Gezira, may well spread to Gezira cotton in due course. No mildew was observed on the X1730A cotton in the Busata Scheme

3. The Southern Sudan.

A visit to Equatoria and Bahr el Ghazal Provinces was made in November 1949. Native cultivations and gardens were inspected and a large number of plant disease specimens were collected. These are being examined and a list will be issued in due course: from those identified to date it appears that a number of diseases, not previously recorded as present in the Sudan, have been collected.

At the Yambio Research Farm various local problems were discussed. The recommendations made after a visit to Yambio in December 1948 as to methods of avoiding the poor germination of cotton seed experienced in the 1948/49 season were put into operation in 1950. Subsequent germination was reported to have been satisfactory.

IV. Experimental Work.

1. Blackarm Disease of Cotton.

A. Disinfection of Cotton Seed against X. malvacearum.

Research into the problem of finding more effective and more convenient methods of treating cotton seed carrying *X. malvacearum* was carried out. The following aspects were investigated (1) Dry treatments--non-mercurial, inorganic mercurial and organo-mercurial powders (2) The vapour effect of certain mercurial dressings (3) The effect of addition of certain dyes to Abavit B powder (4) Steeping of cotton seed in various disinfectant solutions– including pre-soaking in water (5) The "slurry" method as applied to cotton seed. This work will be continued next season at the end of which a full account will be published.

B. The effect of certain Inorganic Mercurial Salts on Cotton Seed Germination and Seeding Development.

The question as to whether treatment of cotton seed with seed dressings containing fairly high content of inorganic mercurial salts can have an adverse effect on subsequent germination or seedling development has often been raised. To obtain some knowledge of the factors involved an investigation was initiated. These factors included the period of soaking in the disinfecting solution and strength and volume of the solution used. Undelinted, delinted and—in a few cases—decorticated seed were used. The effect of dry dressings containing high percentages of mercurial salts was also investigated. Preliminary conclusions are that normal cotton seed is quite resistant to mercuric chloride-iodide solution but that with high dosages or after prolonged soaking seedling development may be depressed although actual percentage germination may not be obviously affected. Acid-delinted seed is much more sensitive in these respects.

C. Blackarm Observations at the Barakat Seed Farm.

The sowing seed for the 1949/50 Barakat Seed Farm cotton crop was treated with extra strong Abavit B (8.5 per cent mercury content as compared with the ordinary 5.67 per cent mercury) in order to reduce seed-borne blackarm infection to as low a figure as possible. Examination of certain areas of the crop were carried out in early September 1949 and the amount of primary seed borne infection was found to be extremely small (10 infected holes in some 51,500 *i.e.*, 0.02 per cent)—although probably not as small as in the previous season when the sowing seed had been liquid treated (no infected holes found in 46,000 examined).

In addition to persistence on seed, blackarm disease can also survive on infected woody cotton debris left on the cotton fields after the final picking and clean up. Two methods of reducing the infectivity of the previous season's cotton fields were tried at the Seed Farm in 1949. Flooding with irrigation water for several days (two to four) did perceptibly reduce the infectivity of old cotton fields but the practical difficulties of flooding for several days were so great that the flooding was by no means satisfactory. Striking reduction in infectivity was obtained by discing with 14" disc ploughs, the operation being carried out by the S.P.S. in June 1949. It was recommended that every effort should be made to plough all 1949/50 cotton fields in this way before the 1950/51 crop is sown.

As part of the general programme for reducing blackarm disease at the Seed Farm it is considered that ploughing of old cotton fields and liquid treatment of the sowing seed (or, until the necessary plant becomes available, treatment with extra strong Abavit powder) are essential.

2. Leaf Curl Disease of Cotton.

A. Transmission Experiments.

Transmission of the cotton leaf curl virus from infected Sakel cotton to various other cottons and other Malvaceae was attempted in late 1949 and early 1950. In all cases whitefly previously caged on infected Sakel cotton were transferred to the plants concerned. Dr. J. B. Hutchinson supplied some of the cotton seeds used from the Shambat collection, whilst seeds of various Malvaceous plants were obtained from the Royal Botanic Gardens, Edinburgh through the good offices of Prof. J. Caldwell. The results are summarised below:—

American cottons (varieties of Gossypium hirsutum L.).

Rogers Acala Upland	.. 37.5 per cent developed very slight but typical mosaic symptoms.
Oaxaca Uaplnd ..	.. 57 per cent developed characteristic mosaic symptoms.
Youngs Acala Upland..	.. 78 per cent developed characteristic mosaic, in some cases severe with much leaf distortion.

Pump Scheme Strain.. ..	43 per cent developed typical mosaic symptoms.
BAR SP. 84 (Seed from Equatoria)	25 per cent developed well defined symptoms of leaf mosaic.
Willd's No. 11 (Seed from Zeidab)	92 per cent developed typical leaf mosaic. In two plants well marked leaf curl symptoms as well as mosaic were present, occasionally on the same leaf, but usually with the leaf curl symptoms on the older leaves.
Enan's Brown Egyptian .. (*G. barbadense* L.)	One plant out of 23 developed a very doubtful mosaic. Appears to be resistant to leaf curl under Gezira conditions.
G. contextum (*punctatum*) ..	No mosaic or leaf curl symptoms appeared but in 83 per cent of the inoculated plants the upper surfaces of some of the leaves were covered with very small papillae. On some leaves there were symptoms suggestive of vein clearing. It is not known whether these symptoms were caused by the leaf curl virus.

Other Malvaceae.

Althaea kurdica, *A. pontica* and *A. sulphurea* developed severe leaf curl symptoms after inoculation, the leaves being strongly curled and with conspicuous vein thickening. No unmistakable enation was seen.

Malva moschata developed slight but well marked discontinuous vein thickening. No enations were seen and the leaves were not strongly curled.

Hibiscus diversifolius and *H. Huegelii* developed no symptoms after inoculation and are presumably immune or highly resistant to the disease.

B. Destruction of Cotton Plants using Weed-Killers.

After the final picking the cotton trees in the Gezira Scheme are removed from the soil using a hand-operated puller. A small experiment to determine whether the plants could be killed by means of hormone weed killers used as sprays was performed. The X1730A cotton trees were cut just above ground level in early April 1949 and were sprayed on the following day. Methoxone, Chloroxone and Phenoxyl were used, each as a 0.1 per cent solution in water at the rate of 100 gallons per acre. Counts of sprouting ratoons were made during the following rainy season. In the unsprayed area 25.1 per cent

of the plants sprouted whilst the figures for the sprayed areas were 25 per cent (Phenoxyl), 16.5 per cent (Methoxone) and 11.8 per cent (Chloroxone). Although some diminution in ratoon growth is evident with the chloroxone spray, the latter by no means killed all the plants and the degree of destruction was not nearly high enough.

3. Other Plant Diseases.

Many specimens were identified during the year and collections made as time permitted, in particular during a visit to Equatoria and Bahr el Ghazal Provinces in November—December 1949. Specimens of plant diseases collected are being identified and a list will be issued in due course.

4. Soil Microbiology.

Work in this subject was confined to an investigation on the effects of certain weed-killers on components of the soil micro-flora, a subject of considerable interest if such weed-killers should ever be used on a large scale in the Gezira or elsewhere in the Sudan.

Certain soil bacteria and fungi were isolated from the soil or from plant roots and grown on culture media containing various concentrations of Chloroxone and Methoxone. Some of the preliminary results are listed below:—

Fusarium sp. (soil isolate).

Methoxone	2,000 p.p.m. lethal. 1,000 p.p.m. greatly retarded growth. 100 p.p.m. had litle effect.
Chloroxone	10,000 p.p.m. and 2,000 p.p.m. greatly retarded growth but were not lethal.

Macrophomina phaseoli (Maubl) Ashby (soil isolate).

Methoxone	2,000 p.p.m. lethal. 1,000 p.p.m. greatly retarded growth. 100 p.p.m. seemed to have a stimulatory rather than a depressant effect on growth in many cases.
Chloroxone	10,000 p.p.m. and 2,000 p.p.m. greatly retarded growth but lower concentrations (*e.g.* 100 p.p.m.) appeared to have a stimulatory effect.

Aspergillus niger Van Tiegh. (soil isolate).

Methoxone	2,000 p.p.m. lethal. 1,000 p.p.m. retarded growth. 100 p.p.m. had little effect.

Chloroxone .. .. .. 10,000 p.p.m. and 2,000 p.p.m. although not lethal had a depressant action on growth. 1,000 p.p.m. and 100 p.p.m. had little effect.

Experiments with a yellow species of *Aspergillus* isolated from soil gave essentially similar results.

Azotobacter chroococcum (soil isolate).

Methoxone .. .. .. inhibited growth at 10,000 p.p.m., greatly retarded it at 1,000 p.p.m. but had little effect at 100 p.p.m.

Rhizobium sp. (isolated from root nodules of *Dolichos lablab* L.).

Methoxone .. .. .. inhibited growth at 10,000 p.p.m., permitted very slight growth on occasions at 1,000 p.p.m. and had little effect at 100 p.p.m.

It will be seen from these results that application of these weed-killers to the soil, at least in dosages at present envisaged, is not likely to have any harmful effect on the soil fungi and bacteria listed above. The apparent stimulation of growth by small doses of hormone weed-killers which was occasionally noted during the course of these experiments is interesting and needs further investigation. As regards effect on soil micro-organisms it appears that methoxone is much more toxic than chloroxone.

Note on Diagram 2.

The abscissae represent the dates on which observations were made at each of the five places, and the ordinates represent the mean numbers of weeds per square metre over 24 50 x 50 cm. quadrants. Dotted lines represent weeded land and entire lines represent controls.

The time of weeding in 1949 is represented by a sudden drop in number. of weeds on the treated land, or by marks / / / on the dotted line.

The residual effect of the previous weeding is shown by the difference between the levels of dotted and entire lines before the start of the present season's weeding.

COTTON BREEDING SECTION

The Gezira Station.

By R. R. Anson and K. C. Barlow.

A. Breeding and Variety Testing.

The Breeding Plot was sown on the 15th August. Germination was slow and irregular. This was most noticeable in Sakel types, and in cases where seed rate had to be low owing to small supplies, complete failure resulted. Weed growth was strong, and heavy rain at the end of August delayed resowing. Later in the season termite damage was considerable and, as a control measure, poisoned sawdust was applied. Blackarm, thought to be primary infection, was first discovered on Sakel progenies on 25th September. The following material was planted and analysed.

Sakel types.

1. *BAR. 14/1=(BAR. 2/10 x Domains Sakel^{5}) B_2 B_2

(a) Twelve selections made for improved lint index and G.O.T. from last season's progenies were again grown in progeny rows alternated with Domains Sakel controls and bulk analysed.

(b) Five selections made from the 300 random plant filter for low node number were tested against controls.

(c) Four small bulks from the best progenies in the previous season were bulk analysed.

2. BLR. 14/16 (BAR. 2/10 x D.S.1^{7}) Blackarm and leaf curl resistant Sakel.

500 plants were selected at random. These have been analysed and will be grown in progeny rows next season.

3. Domains Sakel (Early). In an attempt to produce an early variety of Sakel, six progenies selected for low sympodial position were grown and node numbers recorded.

X.1730 types.

1. BAR.XL. (B. 31 x 1530^{4}) x 1730^{4} b_1 b_1 B_2 B_2 (Selected for good boll opening and good lint).

Thirty nine selections made from BAR.XL and BAR.XL-1 progenies were grown in rows alternated with BAR.XL controls, and analysed.

2. BAR.XL-2 (a second selection from BAR.XL) b_1 b_1 B_2 B_2 (Selected for good boll opening and good lint).

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* See Glossary of Cotton Varieties on P. 78

Twenty eight selections made from BAR.XL-2 progenies were grown in rows, analysed and later discarded because they were not up to standard.

3. BAR. 4/5 (B.31 x 1530^4) x 1730^6 b_1 b_1 B_2 B_2 (Selected for G.O.T. and good boll opening).

Twenty five selections made from former progenies were grown in progeny rows and analysed.

4. BAR. 4/11 (BAR. 3 x 1530 A) x 1730 F) x 1730 G) x 1730 H^7 B_2 B_2 B_3 B_3 (Selected from former progenies for improved yield and quality).

The seed from twenty five selected plants was grown in progeny rows and analysed.

5. BAR. 4/16 (BAR 4/11 x BAR $4/7^2$).

Forty four selections made for improvement were grown in progeny rows and analysed.

6. JR. 1530 (Hairy X.1530).

Six small bulks were grown in the breeding plot and analysed.

B. Boll Development Material.

Plot 86 was used to provide boll development material for the Shirley Institute. This material has been forwarded to the Institute for analysis.

C. Grading Experiments.

Cotton Observation Plot. Dated flowers of 100 *plants from* 5 *varieties.*

It is known that under normal conditions in the Gezira, the best grade comes from the first flush of open bolls which usually come from the lower portion of the plant. These tend to be better nourished and to develop under more humid conditions than bolls higher up the plant. To obtain more information on this subject it was decided to tag flowers on 5 consecutive days at fortnightly intervals. The Chief Classifier of the Sudan Plantations Syndicate very kindly consented to grade the samples. Results were in accordance with expectation, the earliest fruits producing the best grade.

D. Sowing Date Trials (carried out by the Sudan Plantation Syndicate).

Early sowing with slightly wider spacing has been suggested as a means of grade improvement. However, for obvious reasons, early sowing of blackarm susceptible material would have been unwise. When blackarm resistant material became available, an experiment designed to give some information on the advisability of early sowing was set out in 1947/48 season at Fahl. Unfortunately the seed bed was bad, seed did not germinate well and that which did germinate was subject to severe flea beetle attack; added to this, resowings were delayed because they coincided with a festival and labour was unobtainable. In spite of all these catastrophies, the early sown material bulked in a slightly better grade than did the control areas sown at normal time.

The following year 1948/49, 500 acres each were sown early with BAR. 4/5 and BAR. 1730L; these two areas were for comparison with X.1730A. of normal sowing date planted on comparable areas. The season was bad for grade, one of the worst in this respect for many years and this must have masked the advantages of early sowing to some extent. However, the average grade from the early sown material was again slightly better than that from the normal sowing date. In 1949/50, the Sudan Plantations Syndicate carried out another trial. This time the trial was situated on Kumor Block and treatments were as follows:—

A. (1) 70 acres BAR.1730L sown early, wide spacing 50 cms.

(2) 70 ,, ,, ,, normal date, normal spacing (35—40 cms.)

(3) 70 ,, X.1730A control sown normal date, normal spacing (35—40 cms.)

B. (1) 70 acres BAR.1730L-1 sown early, wide spacing 50 cms.

(2) 70 ,, ,, sown normal date, normal spacing (35—40 cms.)

(3) 70 ,, X1730A control sown normal date normal spacing (35—40 cms.)

The early sowing and wide spacing resulted in much improved grade as is shown in the following table:

	Treatment	Yield k.p.f.	Average grade
BAR.1730, L. ..	.. Early and wide	4.68	2.2
,, ..	.. Normal	4.90	4.1
X1730A. ..	.. Normal	6.10	4.1
BAR.1730L-1 ..	.. Early and wide	5.42	2.5
,, ..	.. Normal	4.79	4.7
X1730A. ..	.. Normal	4.89	3.9

E. Leaf Curl Resistance.

Angias earmarked for L/C resistant material were sown on 15th September, one month later than the main Breeding Plot. The object of this was to promote conditions favouring the spread of the disease.

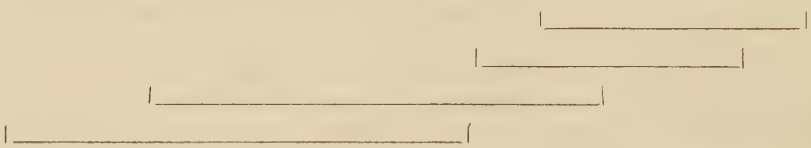
The general design of the experiment was modified slightly in that, instead of alternating individual plants with spreader material, resistant rows were alternated with susceptible rows. Germination was good and growth satisfactory. Throughout the first part of the season there was a complete absence of whitefly and leaf curl. The first trace of leaf curl appeared on 1.4.50 when 13 plants in the spreader belt on the western side of the experiment were found to be slightly infected. Counts made fourteen days later revealed 81 plants (all spreaders) infected. The cotton bushes were cut back on 18.4.50 and left to ratoon. Final counts made on 25.5.50 in which the susceptible material averaged 97.7 per cent infection are shown below:—

Percentage of infected plants in resistant material after cutting back.

Variety	Percentage infection.	
	Variety	Dom. Sakel Control
RDS. 1/48	14.7	95.9
RDS. 2/48	13.3	100.0
RDS. 3/48	18.7	98.7
RDS. 4/48	8.0	98.6
RDS. 6/48	7.4	100.0
BLR. 14/16	12.0	97.3
BLR. 14/1	9.2	95.9
BAR. 1730L	33.3	95.8
BAR. 4/5	10.7	100.0
BAR. 4/11	42.7	97.3
BAR. 4/16	25.6	95.8
X1730A.	32.5	97.3

Chart of Significance.

RDS 6/48	RDS 4/48	BAR 14/1	BAR 4/5	BLR 14/16	RDS 2/48	RDS 1/48	RDS 3/48	BAR 4/16	BAR X1730A	BAR X1730L	BAR 4/11
7.4	8.0	9.5	10.7	12.0	13.3	14.7	18.7	25.6	32.5	33.3	42.7



Treatments within the same bracket do not differ significantly.

Key to Varieties Tested.

RDS. 1/48—6/48 Leaf curl resistant selections from Domain Sakel.
BLR. 14/16 Blackarm res. Sakel sel. for L/C resistance.
BAR. 14/1 ,, ,, ,, ,, ,, ,, ,,
BAR. 1730L ,, ,, 1730 B_2 ,, ,, ,,
BAR. 4/5 ,, ,, ,, ,, ,, ,, ,,
BAR. 4/11 ,, ,, ,, B_2 B_3. ,, ,,
BAR. 4/16 ,, ,, ,, ,, ,, ,, ,,
X1730A. Main crop 1730A. ,, ,, ,,

Leaf curl resistant Sakel obtained from bulkings (selfed material) of Selections 1, 2, 3 and 4 in season 1948/49 were grown on a 4½ acre observation plot at Tokar. No trace of leaf curl was found on this cotton. It averaged 425 lbs of seed cotton per acre, which was considerably more than the adjacent X1730A. Further trials on a larger scale will be made at Tokar next season.

F. Observation Plots.

On the recommendation of the Cotton Varieties Sub-Committee, a number of Egyptian varieties were grown in observation plots. This was done in order to study their behaviour under Gezira conditions and at the same time to ascertain whether an inherent variability for good and bad boll opening exists between one variety and another. These new importations were Karnak, Giza 7, Giza 30 and Menoufi.

The season was a particularly good one for grade and there were not many cases of bad boll opening. There was no marked difference in this phenomenon between varieties. Giza 30 and Menoufi seemed slightly better than the others: Karnak lodged badly and was the most susceptible to thrips attack.

G. Variety Trials. (see Appendices I and II).

With the exclusion of DS.2 and DSS. (mixed) and the addition of BI.R. 14/16, BAR.NT. 2/41 and BAR. 4/11, the variety tests were the same as last season, and were sited in the same areas namely—Gezira Research Farm (centre), Hag Abdulla (south) and Turabi (north).

At the G.R.F. a period of hot dry weather, experienced shortly after germination, retarded growth for a short time but plants recovered with the first rain. Towards the middle of September, blackarm infection, thought to be primary, was noticed on J.R. 1530. This subsequently spread to all susceptible varieties which showed severe symptoms throughout. Conditions at Hag Abdulla were very similar to those at G.R.F. Plants suffered an early set back but afterwards recovered. Throughout the season, blackarm was severe on all susceptible varieties. At Turabi germination was good. Blackarm was present but not severe. In September heavy dust storms checked plant growth on the northern end of the experiment.

Results. At the G.R.F. where blackarm was severe the blackarm resistant varieties of Sakel significantly outyielded the susceptible Domains Sakel. The resistant L cottons all yielded higher than the suceptible L variety (X1730A), but the differences were not significant. At Hag Abdulla where blackarm was also severe, the superiority of the resistant Sakels was very marked, and here the resistant L cotton were also much better than X1730A. At Turabi on the other hand, where blackarm was light, the resistant Sakels yielded significantly less than Domains Sakel, and the resistant L cottons were also poorer than X1730A; in the case of the L cottons carrying B_2 and B_3, differences were significant.

Shambat Station.

By R. L. Knight and J. E. W. Sadd.

Production of blackarm resistant "Egyptian" varieties.

1. *Blackarm resistant Domains Sakel.*

In last season's report the genesis of BLR. 14/16 was given. This strain of Domains Sakel is resistant to blackarm by reason of the gene B_2 and it was made resistant to leaf curl by straight selection on a very wide basis within its parent variety BAR. 14/7.

One feddan of BLR. 14/16 was sown with bulked seed of 242 leaf curl free plants on 30th October 1948. This was cut back on 4th May 1949, at the end of crop and, when secondary growth had started, was regularly rogued for leaf curl. 694 leaf curl affected plants were removed during the summer. A further 1851 plants were pulled up as being possibly lacking in vigour and the 2,032 plants which remained were then treated as an isolated propagation plot. Seed from these was used to sow a five feddan propagation area from which will come a second wave of BLR. 14/16 presumably even more resistant to leaf curl than was the original material.

The production of a strain of Sakel carrying both B_2 and B_3 was completed this season and $\frac{1}{3}$ feddan was sown with this new type on 11th January 1950 under the reference number BAR 14/21. It is intended to make this resistant to leaf curl next season by the same process as was used in creating BLR. 14/16 from its parent type BAR. 14/7.

The transference of the *arboreum* gene B_4 to Evelyn's Selected Sakel was completed this season and a small propagation plot of 10th *barbadense* backcross (6th backcross to Evelyn's Sakel) material, homozygous for B_4, was grown under the reference number BAR. 14 19.

In a second transference from tetraploid *sanguineum* (*G. arboreum* race *bengalense*, Silow) to Sakel, a number of third backcross families were successfully grown and selected plants of these were further backcrossed to Sakel. Susceptible plants in these progenies were crossed with BLR. 14/16 so as to pick out the main blackarm resistance intensifying gene, if present. The major objectives in making this second transference from *arboreum* were given in last season's report.

In the hybridization between tetraploid *herbaceum* (Wagad 8) and Sakel, the *herbaceum* gene for blackarm resistance was successfully taken to the third backcross, and fourth backcross seed was obtained for sowing next season. The relationship between this *herbaceum* and the *arboreum* B_4 is not yet known.

B_5, the gene from the perennial *barbadense* type, Grenadines White Pollen, was successfully carried to the fourth Sakel backcross, and fifth backcross seed was obtained for sowing next season.

2. *Blackarm resistant X.1730.*

No further work is being done at Shambat on blackarm resistant X.1730 types because sufficient variability appears to exist in BAR. 4/16 (B_2 B_3 1730) to make it suitable for selection work by the cotton breeders at Medani.

PRODUCTION OF BLACKARM RESISTANT STRAINS OF AMERICAN UPLAND AND THE EXAMINATION OF IMPORTED UPLAND TYPES.

A crossing programme was started this season to incorporate B_3 into BAR.NT. 96/40, a type from Kadugli homozygous for B_2. As a start BAR. 7/8 (a B_2 B_3 strain of Uganda SP. 84) was crossed with BAR.NT. 96 40 on a wide basis and the F_1 of this cross will be sown next season and used for backcrossing to BAR.NT. 96/40.

C (48) 4 (a BP. 52 stock from Namulonge) was examined for blackarm resistance in 1949—50 winter. It contained 213 resistant plants and 69 susceptible; there were in addition, 4 resistant plants whose classification was doubtful. The resistant plants were individually selfed and these will be sown in progeny rows next season, in order to get a 'bulk' homozygous for B_2. The transference of B_3 to these resistant plants was begun but, over and above this, an attempt will be made to increase the resistance of the B_2 component by spraying with blackarm each season and selecting for maximum resistance, thus building up a gene complex fortifying B_2.

The gene controlling the blackarm resistance of Stoneville 20 has been transferred by three backcrosses to a sufficiently uniform Sakel background for its value to be determined next season. In addition, individual F_1s of Stoneville 20 carrying B_1, B_2, B_3, B_4 and B_5 respectively were grown, so that gene homology tests can be carried out next season on F_2 material.

The blackarm resistance of *G. anomalum* is recessive. Material selfed out from second backcrosses to susceptible *G. arboreum* (Java) was grown this season and the resistant plants in this were again crossed with Java. It is intended, next season, to make crosses with an *arboreum* carrying B_4 so that the relationship between blackarm resistance in *G. arboreum* and its wild relative *G. anomalum*, can be investigated.

JASSID RESISTANCE.

This season the full MU8b hairiness was recovered in F_2s of the third Sakel backcrosses. The resistance of MU8b has been shown to depend on a basic hairiness gene H_1, fortified by modifying genes and by minor genes having of themselves a direct action on the production of hairs.

In the transferences from Ferguson, the full parental hairiness was recovered in the third backcross F_2s, but many of the families still carried a high degree of sterility. The hairiness mechanism of Ferguson is also based on a key H gene (whose relationship with the other known genes H_1, H_2 and H_3 has not yet been determined), accompanied by length intensifiers. The number of length intensifiers involved appears, fortunately, to be small.

This season, jassids were general and severe and the immunity of these types selfed out from Sakel backcrosses involving MU8b and Ferguson was outstanding.

The basic gene controlling hairiness in Kapas Purao is H_3 and this is closely linked with one of a pair of duplicate genes for chlorosis. In Kapas Purao this gene is harmless, but transferring H_3 to Sakel has so far given chlorotics as a final product. This gene has now been carried to the 7th Sakel backcross, and 8th backcross material will be sown next season and selfed to see whether this linkage has been broken.

The hairiness gene from pubescent T.611 has been transferred as far as the 3rd Sakel backcross, and 4th backcross seed is available for sowing next season. This gene is the strongest H gene so far studied.

In crosses involving *G. tomentosum*, the hair density gene H_2 was taken to the 5th Sakel backcross. It is of interest that at this stage it was still associated with a shortening of the leaf lobes, as noted by Harland.

In transferring hairiness from *G. arboreum* and *G. herbaceum* the basic H genes were successfully carried to the third Sakel backcross, and fourth backcross seed has been obtained for sowing next season.

Other crosses involving *G. mustelinum*, *G. punctatum*, St. Ignatius and hairy Giza 36 were also carried out.

Major hairiness in cotton always appears to be controlled by a main gene stepped up, either by minor genes, or by intensifying genes or both.

For breeding purposes the gene H_1 has been chosen as the most hopeful one around which to build synthetic, jassid-resistant Sakels. This gene was chosen partly because it is common to *G. barbadense* (Tanguis and Carpulla) and *G. hirsutum* (MU8b and St. Ignatius), but also because it has proved to have no deleterious effects on lint quality. This was shown in last season's report by means of a comparison of JR. 14/5 (carrying H_1) with Evelyn's Sakel.

In almost all of these jassid-resistance transferences, therefore, it will be necessary to have as a recurrent parent for the last few backcrosses, a Sakel homozygous for H_1 and at the same time resistant to leaf curl and blackarm. This has now been made by backcrossing JR. 14 5 to BAR. 14 7 and latterly to BLR. 14 16 and the new strain will be in small bulk next season under the number BLJR. 14/23. It is not intended that this shall ever become a commercial strain—it has been made solely for use as a backcross parent and although it will ultimately go into variety tests in the Gezira, the objective will be solely to make sure that BLJR. 14/23 is fully up to expectation in every way.

Following BLJR. 14 23 is a wave of material carrying both B_2 and B_3 and this will form the ultimate backcross parent in this work.

Transference of lint strength from G. thurberi to Sakel.

The background of this work is given in last season's report.

The Shirley Institute's report on the samples of (*G. "thurbadense"* x Sakel^3) x BAR. 14 7 F_1 sent there last season, showed that the extra strength derived from *G. thurberi* had been lost. This was not unexpected since, in the previous season, the hybrid parents had suffered such a severe attack of leaf curl that they became useless as female parents and had to be used as males in backcrossing. Pollen grains carrying an extra (*thurberi*) chromosome would probably be at a disadvantage in fertilization and this is almost certainly the reason for the loss of the extra strength.

This season, therefore, seed of 1947 origin was sown to recover the extra strength from this earlier material. Hand tests of the material suggest that the strength is in fact present and lint has been sent to the Shirley Institute from 19 plants selected as being the strongest in the (*G. thurberi* x Sakel^4) x BAR. 14/7 F_1 families, and from 65 of the strongest plants in the *G. thurberi* x Sakel^4 F_2's.

Yield.

Apart from the provision of disease resistance by hybridization, the improvement of the yielding capacity of X. 1730 and Sakel is largely a matter of straight selection, and such selection is in fact being carried out at Medani. Nevertheless it seems probable that the process can be helped by hybridization. Thus one of the characters on which yield is ultimately based is the number of locules per boll. The transfer of 4-loculed bolls to Sakel will not necessarily increase yield immediately, but such a Sakel would obviously offer more scope for selection for high yield.

Accordingly this 4-loculed character is being transferred to BLR. 14/16. This season, the character was successfully transferred to the 3rd Sakel backcross stage from tetraploid *G. herbaceum*, and also from tetraploid *G. arboreum*, and to the 4th backcross from *G. hirsutum* (Ferguson). Further backcrosses were made in each case and these will be sown next season.

A second possibility for augmenting the capacity of a strain to respond to selection for increased yield, is to raise the number of seeds per locule. With this end in view, seed of *G. auritum* has been obtained from America. This 'species' has 12—13 seeds per locule and it is intended to try transferring some or all of this increased number to Sakel (which normally has 6—7).

Diseases and Pests.

Leaf-curl was moderately severe though less so than last season.

Pink and Egyptian bollworms were very troublesome.

Jassids caused heavy bud and boll shedding and leaf mortality during the first half of the season.

Rhizoctonia wilt was more widespread than it has ever been during the last 21 years at Shambat. This spread is probably attributable to the use of a tractor for ploughing and cultivation.

Kadugli Station

By M. F. Rose.

Climate.

The complete absence of rain in April and the relatively heavy rains in May were the prelude to the poor planting rains of June and early July. The timely precipitation of 40 mm on July 25th saved all breeding stocks and field experiments (planted on June 26th), and was really the first good planting rain of the season. From this date the sequence was excellent and those areas which had survived the early drought gave good yields. Late October rains (46.5 mm on October 19th) raised the level of both yield and quality, and final returns from the Experimental Farm averaged 1500 lbs of seed cotton per acre. Outlying areas experienced the same sort of rainfall conditions and much of the early crop was drought—stricken and subsequently abandoned. Data for the season are presented in Table I.

Table I.
Rainfall mm.

	F	M	A	M	J	J	A	S	O	N	D	Total
1910-1948	2	1	15	78	123	151	154	138	81	6	—	749
1949 ..	—	—	—	113	82	99	158	169	117	—	—	738

Temperatures (Centigrade).

	Mean Max	Range	Mean Min.	Range
Resting Period Dec.—May	36.7	27—44	20.6	12—30
Growth Period June—Nov.	32.8	23—39	20.0	10—28

Cotton.

The Commercial Crop.

In view of the issue of 1,000 tons of seed for the 1949—50 season and the eagerness of the cultivator to obtain as large a quota as possible, high hopes were entertained for a marked increase in seed cotton production over the previous season's figure of nearly 10,000 tons. Final figures (March 1950) for the 1949/50 cotton market showed a yield of about the same as the previous season. Assuming that the bulk of the seed issued would be planted, an increase of over 70 per cent had been confidently expected.

The causes contributing to these disappointing returns were (i) badly distributed rains and poor planting conditions up to July 25th: much of the crop planted before this date was lost: (ii) very late re-planting (mid-August) with the inevitable reduction in final yield (iii) very severe damage from Sudan, Egyptian and pink bollworm (iv) poor conditions generally being superimposed on poor sowing—seed from the previous season (the worst on record) (v) greater attention being paid to the dura crop (due to an anticipated food shortage) and consequent neglect of the standing cotton crop: (vi) shortage of pickers in November and December and the loss of much seed cotton on the ground.

Cotton Selection.

The breeding plot had the following four groups: BAR SP.84 (104 progeny rows), CL 20—4 (5 progeny rows), MZ 561 (four progeny rows), Wilds 11 ex Zeidab (67 progeny rows). Small special bulks of A2106, A220 and A292 (U4 x Cambodia) and A332, A449 and A455 (U4 x MU8) were also included for observation, their type being maintained by selfing. The six groups have been fully described in the 1948—49 report in which the general policy towards each was formulated. All material was badly affected by the early season's drought and had to be maintained by hand watering. From July 25th however, excellent conditions prevailed and the late October rains did much to improve general quality: individual plant yields were well above average.

In BAR. SP.84, 43 progeny rows have been retained for subsequent work: it is apparent, however, from field observation and laboratory analyses that there has been a marked levelling—up (both within and between lots) of the more important characteristics and that the variability for future selection work must be sought elsewhere. To this end an extensive crossing programme was undertaken involving the eight nuclei already derived from BAR SP. 84 and BAR NT. 96/40 (see cotton hybridization).

In spite of their earliness, 8,121 derivatives (ex type MZ 561) have been discarded in favour of 8,131 and 8,134 (ex type CL 20—4). Under local conditions they failed to approach the latter in yield potential (see miscellaneous variety trial) and spinning qualities.

Of the 67 progeny rows from Wilds 11, being selected for earliness, nine have been retained: their mean node numbers range from 5.8—6.2. A comparison of the overall node number (mean) for season 1948 with that of 1949 (mean node number from the 67 progeny rows) shows a value constant at 6.5. Figures from the 1950 season will be of interest and should give some indication as to whether this line of work merits further pursuit.

The three U4 x MU8 derivatives, although yielding slightly less than their Cambodia counterparts, have again proved earlier and more mature in fibre characters. They seem better adapted to the short growing period of the Kadugli area and will be tested in variety trials against the best BAR SP. 84 selections in the 1950/51 season: A2106, A292 and A220 will be dropped.

Cotton Hybridization.

Plants typical of the strain BAR NT. 96/40 were crossed with the eight nuclei from BAR SP. 84 Nos. 853, 857, 840, 841, 891, 861, 862 and 836. BAR NT.96/40, originally derived from the cross 57 x Over-the-Top and rendered homozygous for B_2, has had a good record in Kordofan and, although a mid-season type, is not so late as the old commercial Pump Scheme Strain. Over a number of seasons and localities, its mean fibre characters do not differ markedly from those of BAR SP. 84 although its standard hair weight tends to be slightly higher. It is very prolific, with large bolls which open well, and the transfer of its robustness and vigour to the more delicate type, BAR SP.84, is the first essential of the cross. Sixty individual crosses were made with each pair, and with reciprocal crossing, the programme has given 16 lots of F1 seed for the coming season.

Four further lots of F1 seed are available, derived from the inter-strain crosses 840 x 862 and 841 x 857 (direct and reciprocal). It is hoped to transfer the excellent fibre properties of the finer-wooded types, 840 and 841, to the stronger—wooded, robuster types, 862 and 857.

Propagation of Commercial Stocks.

(a) Isolated plots (1/20 acre each) of the eight strains selected from BAR SP.84 were planted out on June 26th. Adequate seed is available from each for a bulking-up programme at El Effein in the coming season.

(b) An area of 230 acres of BAR. 7/8 (a BAR SP.84 derivative homozygous for B_2 and B_3) was planted out at Gennaya, 20 miles north of Kadugli. In spite of late planting (mid-August), the crop appeared healthy and vigorous and in early November showed very marked resistance to blackarm. Towards the end of the month, however, there appeared a falling-off in this resistance but even so its superiority to the commercial bulk (BAR SP.84) in adjacent areas was strongly in evidence. The type was very heavy fruiting and figures to date indicate a minimum return over the whole area of 500 lbs. of seed cotton per acre. In view of the conditions under which the crop was grown, such a yield is good. The yielding capacity of BAR 7/8 was also demonstrated in the variety trials and its superiority to BAR SP.84 in blackarm resistance was amply demonstrated in controlled spraying experiments (see Blackarm). Its lint, however, is shorter and harsher than that of BAR SP.84 but there is evidence that this defect can be remedied by selection within the crop. Four hundred and thirty single plants were taken from Gennaya for filtering, and laboratory figures indicate a promising degree of variability. Final judgement on this type must be reserved, however, until data from large scale spinning tests are available.

Variety Trials.

In spite of bad conditions and heavy bollworm attack the intra—BAR SP.84 and the miscellaneous variety trials (planted June 26th) gave mean returns of 560 and 594 lbs. of lint per acre respectively. Relevant data are given below followed by a short discussion of the strains in question.

TABLE II.

Intra—BAR SP. 84 V.T.			Miscellaneous V.T.		
Strain	G.O.T.	Lint per acre(lbs)	Strain	G.O.T.	Lint per acre(lbs.)
861	35.9	677	8134	32.1	644
BAR SP. 84 S	34.9	598	BAR. 7/8	35.0	623
BAR SP. 84	33.1	570	BAR. SP. 84	33.6	620
853....	36.1	554	8131	31.8	619
862....	34.6	548	8121	29.8	580
857....	35.9	531	BAR. NT 205/47	36.7	553
840....	34.1	529	BAR. NT 205/43	32.8	516
836....	33.1	521			
841....	34.2	516			
Diff. required for 5 per cent level= 47 lbs.			Diff required for 5 per cent level= 77lbs.		

In the intra-BAR SP.84 V.T., strain 861 outyielded the parental bulk by 107 lbs. of lint per acre, an increase of 19 per cent. Further proof of its high yielding capacity was given by its nucleus (1/10 acre) which returned 572 lbs. of lint per acre outyielding its nearest competitor, 862, by 30 per cent. There can be little doubt as to the yielding capacity of this strain but as regards strength and maturity it falls well below that of 840 and 841 ; these quality types, unfortunately, appear well down in the list of final yields. BAR SP.84 S. (BAR 7/3), selected directly from BAR SP.84 for its higher G.O.T., has not significantly outyielded the latter.

In the miscellaneous V.T., 8134 (ex C.L. 20—4) heads the list with 644 lbs. of good quality lint per acre. Owing to the high error of the experiment, it outyields significantly only the two varieties BAR NT. 205/47 and BAR NT. 205/43 : these latter (ex SP.20) were of U4 4 2 origin and, when first introduced, were considered as potential rivals of BAR SP. 84 : the yield from 8121 (ex MZ. 561) is disappointing and in view of the gradual falling-off in its lint quality this strain has been dropped.

Multifactor Experiment.

The results from a 3^4 experiment, planted on July 20th are given in Table III. Owing to the erratic rainfall, the planting date was unavoidably late and this fact combined with heavy bollworm attack reduced the mean yield of the experiment to 210 lbs. of lint per acre.

The treatments were as follows :—

Seed Rate.

R0 = 10 seeds per hill at planting
R1 = 15 ,, ,, ,, ,, ,,
R2 = 20 ,, ,, ,, ,, ,,

Thinning Date.

To — Thinning to 6 plants per hill 15 days after planting and 10 days later to the final stand

T1 — „ „ „ „ „ 25 days after planting and 10 days later to the final stand.

T2 — Thinning to final stand 35 days after planting (native practice)

Intra-row Spacing.

So — 45 cms. between hills

S1 — 60 „ „ „

S2 — 90 „ „ „

Stand.

Ho — 2 plants per hill at final thinning.

H1 — 3 „ „ „ „ „ „

H2 — 4 „ „ „ „ „ „

Treatment means are given below (Table III). None of the first order interactions was significant and their values have been omitted.

TABLE III.

Lbs. lint per acre. Bar SP. 84.

Ro = 216	To = 211	So = 237 (136)	Ho = 191 (89)
R1 = 207	T1 = 209	S1 = 219 (126)	H1 = 214 (100)
R2 = 208	T2 = 210	S2 = 174 (100)	H2 = 225 (105)

SE = $\pm$ 4.8

For the fourth consecutive year the superiority of the closer spacing (45 cms.) over the wide commercial (90 cms.) has been demonstrated, the present season's increase being of the order of 36 per cent. The figures also support the high interaction value of Variety x Plants per hill (V.H.) of the previous season's experiment in which it was evident that the finer wooded type, BAR SP.84, could tolerate a higher hill population than the stronger wooded, coarser types, Pump Scheme and BAR NT. 96/40.

The almost significant difference in favour of the lowest seeding (Ro=10) can be accepted only in terms of the excellent sequence of rains following the planting of the experiment. On the breeding plot where every endeavour is made to create an ideal seed-bed, an emergence of 2 to 3 seedlings only, per 10 acid-treated, water-sinkers planted, can be expected if planting is not followed by rain. Hot, drying winds can set the surface to the consistency of concrete and a light seeding fails to emerge. The cultivator, well aware of the local soil type, throws in a handful of seed ranging from 15 to 25 ; without following rains, such a seeding can break the surface crust and give fair stands but under such circumstances intra-hill competition becomes acute at a very early stage and the young seedling is adversely affected. On these black clays it is obvious that a balance must be struck between the opposing requirements of stand and subsequent development.

Eleven days from planting date, germination counts were made over the 3 levels of seed-rate and such figures converted to percentage emergence ; for Ro, R1, R2, these were shown to be 70.5, 73.3 and 54.3 per cent respectively. The fall in emergence percentage with the highest seed-rate is highly significant and points to an adverse conditioning of the seedling at a very early stage.

The prescribing of a fixed seed-rate to meet the varied demands of both soil and season is difficult but past experience indicates that the planting of 15 seeds per hill will meet average requirements. At this seed-rate and the commercial spacing of roughly 1 metre x 1 metre, the cultivator is fully justified in demanding seed at 18 lbs. per acre (14 lbs. planting plus 4 lbs. gap-filling) and any attempt to reduce this figure would be false economy.

With the very high seeding per hill necessitated by soil type, early thinning becomes of primary importance. Fearing damage by termites, grasshoppers and millipedes, the cultivator postpones the thinning of his ' clumps ' to the latest possible date and then thins in one operation. Although not demonstrated in the present experiment, such a practice produces a leggy type of plant and adversely affects final yield. Under local conditions, treatment To has been accepted as standard practice.

Diseases and Pests.

(a) *Blackarm.* In general, blackarm was in evidence in the commercial crop throughout the season and most markedly in those areas where planting had been delayed until mid-August. Its intensity and spread can be more closely followed in Table IV which lists resistant, very resistant and susceptible varieties. As in the season 1947—48, the gene B_2 was hardly sufficient to cope with the worst conditions of infection, but under such circumstances BAR 7/8 (B_2 B_2 B_3 B_3) offered excellent resistance ; although planted in August (Gennaya) this type gave seed cotton of marked cleanliness, even in the late pickings. The figures shown in Table IV were obtained from sprayed guard-rows in the miscellaneous V.T. (planted June 26th : sprayed August 15th :) and indicate the general development of the disease as the season advanced.

TABLE IV.

Date	Variety	Percent infected	Mean B.A. Grade	
1st count Aug. 31st	BAR SP. 84	21.0	4.7	Approx. 500 plants counted per strains per occasion.
	BAR SP. 84 S	3.2	4.6	
	BAR 7/8	0	—	
	Pump Scheme	100.0	8.0	
2nd count Sept. 9th	BAR SP. 84	38.8	5.7	
	BAR SP. 84 S	20.4	4.6	
	BAR 7/8	3.5	3.7	
	Pump Scheme	100.0	9.0	
3rd count Sept. 18th	BAR SP. 84	73.9	4.5	
	BAR SP. 84 S	66.5	4.3	
	BAR 7/8	11.0	3.6	
	Pump Scheme	100.0	9.2	

In the 3^4 experiment, late planted on July 20th with BAR SP.84 there was 100 per cent infection with a mean blackarm grade of 6.7. Such a degree of infection was equivalent to that on all late plantings in the area and gives a fair measure of the general intensity of the disease.

(b) *Bollworms*. The present season was probably the worst on record for bollworm attack. Sudan and Egyptian made their appearance in the crop in early August and losses from these two pests continued to the end of the growing season. The early crop was either completely lost or so badly damaged that quality was seriously impaired : down-grading was severe in all early markets.

Regarding pink bollworm, boll samples taken from the Main and Kamina Farms on November 15th showed infection figures of 54 per cent and 35 per cent respectively. Taken in conjunction with the date, these figures are very serious.

(c) *Flea beetle* (*Podagrica puncticollis*). Damage to the young crop by flea beetle was controlled by dusting with DDT powder. This pest, however, was most persistent throughout the whole season and marked puncturing of leaves was in evidence up to the closing down of the crop.

(d) *Cotton leaf roller* (*Sylepta derogata*). The pest made its appearance in early August and persisted in the crop until the end of October. Outside areas suffered severly but in experimental fields the pest was controlled by the plucking of infected leaves.

(e) *Stainers* (*Dysdercus fasciatus and superstitiosus*). The first migrants appeared in experimental cotton on September 25th : the subsequent population did little damage, and in the Kadugli area the commercial crop showed little signs of staining from these insects.

Other Crops.

Commercial stocks of four early, eleven mid-season and four late types of dura were maintained by appropriate methods. Of the seven special bulks of lubia helu (*Vigna unguiculata*), 3 lots—Kadulgi 4, 3 and 47—have been retained for bulk propagation. They are resistant to the local leaf mosaic and cover the range of types required for the Nuba Mountains. They can be shortly described as (i) Kadugli 4—a late fodder type, red seed, (ii) Kadugli 3—mid-season, dual purpose type, brown seed (iii) Kadugli 47—an early type, white seed. The two sesame varieties, Kadugli Resistant White and Kadugli Early Resistant White were maintained in one acre blocks. The demand for these types, resistant to the local Marad Ed Dam disease (*Bacterium sesami*), has far exceeded available supply. Small areas (1/5 acre) of the four groundnut varieties. Barberton, Medani Erect, American Erect and Abu Arbaa were also grown.

Plant Propagation.

by

C. G. Webster

Food Crops.

Dura.

Dwarf White Milo was propagated over an area of 16 feddans It was noted with particular interest that the crop, maturing evenly in 100 days at a uniform height of 5 ft. was free of the undesirable pendent head and that lodging was negligible. Propagation of Feterita Dwarf Managil and Dwarf Gassabi by the approved growers in the Managil rainlands continued and yields were sufficient for our requirements. Feterita Wad Hussein grew well at the Abdel Magid Prison Area and yielded 1000 rotls per feddan. A number of varieties were grown on a small scale at Radma, (Sudan Plantations Syndicate Ltd.) and on the G.R.F. for observation and seed maintenance. Previous reports on all varieties were confirmed.

Dukhn.

The Kordofan types ECR/205A Yellow Awned, ECR/205B Black Awned and the Nigerian ECR/344 Maigashi were again heavily rogued and the bulk seed is now considered to be about 80 per cent pure. Birds preferred the Nigerian variety, reducing the crop on one area to 20 r.p.f.

Maize.

The maize trials were a failure. Few plants of the six varieties sown for observation and seed increase survived the heavy stemborer and termite attacks. The bulking of ECR/321 Mexican June yielded 200 r.p.f.

Wheat.

The 6 introductions selected from last season's trials were under observation. They were not comparable to ECR/1060 Hindi 62 nor to the Beladi selections ECR 1062 Beladi Red, and ECR/1063 Beladi White as regards growth, yield and resistance to pest attack.

Barley.

An early maturing variety ECR/556 Egyptian 16 was grown for seed maintenance. Growth was good yielding 850 r.p.f.

Oil Crops.

Soya.

The propagation of the 9 varieties during the summer was not a success. Within ten days of sowing, the poor stand was overrun by blister beetle and a month later termites did their best to wipe out the survivors. Continuous re-sowing was a failure. Five varieties, 3 shattering and 2 non-shattering types, were chosen for a winter trial. Winter sowings revealed a superiority of the shattering varieties. In striking contrast to the poor growth and high mortality rate of the non-shattering types, the shattering varieties, ECR/937 and 974 from the Belgian Congo and ECR/999 Avoyelles from U.S.A. grew well.

Sunflower.

The most outstanding variety of this season's trials was Saratov ECR/623. With uniform, well filled heads maturing in 80 days this dwarf (4 ft.) single-headed variety yielded at the rate of 1300 r.p.f. Other varieties showing promise were ECR/827, 834 and 841.

Safflower.

No difficulty was experienced in establishing and maintaining a complete stand of the 3 varieties under trial. Throughout their development the plants showed vigour and balanced growth. The local spiny variety ECR/601 Debeira produced 1526 r.p.f. and the spineless U.S.A. introductions ECR/864 and 866, 1429 r.p.f. and 1112 r.p.f. respectively.

Groundnuts.

Of the 15 varieties selected last year for further observation, 9 go forward for trial in 1950. The discards were either mixed runner or spontaneous germination types. In addition 4 varieties were propagated for seed increase. Beladi Bunch ECR/419 with the highest yield, 1600 r.p.f. unshelled, claimed particular attention because of the cover afforded by its luxuriant healthy growth.

Sesame.

An importation from the U.S.A., ECR/972 Nebraska, and a Gedaref selection for earliness, ECR/991 Hiraher Khafeef, were under observation. It was recorded in Plant Propagation Report 1948/49 that ECR/972 was a non-shattering type. Our observations this season do not confirm this ; it ripened unevenly, shattering the pods 100 to 120 days after sowing. The Nebraska variety's behaviour was in fact very disappointing. Germination was poor and the weak growth showed little or no resistance to pest and disease attack. Webworm (*Antigastra catalaunalis*) in particular did severe damage. In comparison to ECR/991 the average height was 32 cm. as against 80 cm. and the average number of capsules per plant 9 as against 55. Yields were in the ratio of 1 : 10.

Pulse Crops.

Cowpeas.

Last season's selected introduction, 10 varieties, were under observation. None of them was outstanding or superior in any way to those already held. The best of our varieties ECR/77, 78, 79, 169 and 860 were sown for seed increase.

Beans.

The early maturing ECR 67 Cluster Bean, ECR/769 Tepary Bean and the late maturing varieties ECR/757 Sword Bean, ECR/770 Jack Bean and ECR 856 Velvet Bean were sown for seed increase with satisfactory results.

Various.

Babun ECR/174 and Phillepesara ECR/114 were grown for further observation and seed increase. The study of Phillepesara as a possible fodder-smother crop will be undertaken next season.

Forage Crops.

The Indian lubias ECR/127, 135 and Sweet Sudan Grasd ECR/1013 were propagated for seed increase. Growth was good ans yields average.

Vegetable Crops.

Bamia.

Four varieties, ECR/488 Bamia Mumtaza, ECR/967, 968 and 969 were propagated for seed increase.

Potatoes.

Severe jassid damage to the promising U.S.A. varieties ECR/915, 916, 917, 918 resulted in very poor yields of small tubers.

Sweet potatoes.

As substitutes for the expensive potato the varieties ECR/883 Porto Rico and ECR/884 Nancy Hall were in keen demand.

Seed Distribution.

In addition to the bulk distribution of 80 tons dura seed to Government departments, 1 ton, in parcels of 1 to 200 rotls, was supplied to 40 small farmers. This marked increased interest by the cultivator in our seed is most gratifying.

Seed samples of food, oil, forage and fibre crops were requested by and supplied to 13 countries outside the Sudan.

Appendix I.

Gezira Variety Trials 1949/50.

Variety	Bar Gene	G.R.F. (Blackarm severe)			Hag Abdulla (Blackarm severe)			Turabi (Blackarm light)		
		Seed cotton lbs. per acre	Lint. lbs. per acre	G.O.T.	Seed cotton lbs. per acre	Lint lbs. per acre	G.O.T.	Seed cotton lbs. per acre	Lint lbs. per acre	G.O.T.
Sakel Group.										
DS1	—	1149.3	382.7	33.3	696.0	221.3	31.8	1478.2	489.3	33.1
DS Control	—	1097.2	353.3	32.2	619.7	191.5	30.9	1465.4	467.4	31.9
RDS	—	1331.0	465.8	35.0	619.7	203.9	32.9	1333.8	473.5	35.3
BAR. 14/7	B_2	1394.4	407.2	29.2	1057.2	299.2	28.3	1230.1	365.3	29.7
BLR. 14/6	B_2	1342.2	387.9	28.9						
BAR. NT. 2/41	B_2				1574.3	466.0	29.6	1199.2	368.1	30.7
X. 1730 *Group.*										
XAG	—	1323.9	467.3	35.3	994.7	334.2	33.6	1414.3	492.2	34.8
XAT	—	1354.5	484.9	35.8	894.7	308.7	34.5	1330.1	458.9	34.5
BAR. XL	B_2	1393.4	516.9	37.1	1265.8	434.2	34.3	1355.6	479.9	35.4
BAR. XL-1	B_2	1491.5	526.5	35.3	1304.6	434.4	33.3	1327.8	462.1	34.8
BAR. XL-2	B_2	1429.1	505.9	35.4	1298.6	432.5	33.3	1255.6	429.4	34.2
BAR. 4/5	B_2	1445.1	484.1	33.5	1341.1	423.9	31.6	1149.6	370.2	32.2
BAR. 4/11	B_2B_3	1376.1	455.5	33.1	1340.1	419.4	31.3	1197.7	389.2	32.5
BAR. 4/16	B_2B_3	1400.0	464.8	33.2	1337.5	420.0	31.4	1053.4	347.6	33.0
JR. 1530	—	1032.9	401.8	38.9	660.5	253.0	38.3	1369.9	520.6	38.0

At the 5 per cent level the significant differences for seed cotton were 172.4, 150.0 and 136.1 lbs. per acre at the G.R.F., Hag Abdulla and Turabi respectively.

Summary of Performance of Current Strains in Gezira Variety Trials.

Variety.	SEED COTTON						LINT						Location.
	No. of Trials	Rotls per feddan			Variety as % of		No. of Trials	Rotls per feddan.			Variety as % of		
		Variety	X1730A	Dom Sak.	X1730A	Dom. Sak.		Variety	X1730A	Dom. Sak.	X1730A	Dom. Sak.	
Domains Sakel	11	1132	1199	1132	94	100	11	361	412	361	88	100	NORTHERN GEZIRA
D.S.1	5	996	1084	1021	92	98	5	324	381	329	85	98	
BAR. 14/7	1	1230	1414	1465	87	84	1	365	492	467	74	78	
BAR. NT. 2/41	7	1279	1319	1293	97	99	7	368	450	396	82	93	
X1730A	11	1199	1199	1132	100	106	11	412	412	361	100	114	
X1730A ex Tokar	4	1109	1124	1044	99	106	4	394	398	339	99	116	
BAR. 1730L.	10	1182	1232	1176	96	101	10	419	424	377	99	111	
BAR. 1730L.1	5	994	1084	1021	92	97	5	345	381	329	91	105	
BAR. 4/16	1	1053	1414	1465	74	72	1	348	492	467	71	75	
Domains Sakel	24	1585	1868	1585	85	100	24	499	655	499	76	100	CENTRAL GEZIRA
D.S.1	6	1338	1525	1295	88	103	6	431	545	409	79	105	
BAR. 14/7	2	1511	1530	1194	99	127	2	442	538	383	82	115	
BLR. 14/16	1	1342	1324	1097	101	122	1	388	467	353	83	110	
BAR. NT. 2/41	8	1791	1750	1621	102	110	8	552	614	511	90	108	
X1730A	24	1868	1868	1585	100	118	24	655	655	499	100	131	
X1730A ex Tokar	4	1724	1766	1341	98	129	4	610	613	424	100	144	
BAR. 1730L.	12	1711	1739	1528	98	112	12	623	614	483	101	129	
BAR. 1730L.1	6	1749	1700	1411	103	124	6	612	602	442	102	138	
BAR. 4/16	2	1800	1530	1194	118	151	2	600	538	383	112	157	
Domains Sakel	7	1362	1547	1362	88	100	7	433	549	433	79	100	SOUTHERN GEZIRA
D.S.1	4	1173	1476	1151	79	102	4	386	521	378	74	102	
BAR. 14/7	1	1057	995	620	106	170	1	299	334	192	90	155	
BAR. NT. 2/41	4	1734	1513	1393	115	124	4	524	524	428	100	122	
X1730A	7	1547	1547	1362	100	114	7	548	549	433	100	127	
X1730A ex Tokar	4	1421	1476	1151	96	123	4	509	521	378	98	135	
BAR. 1730L.	7	1574	1547	1362	102	116	7	568	549	433	103	131	
BAR. 1730L.1	5	1476	1411	1116	105	132	5	519	494	362	105	143	
BAR. 4/16	1	1338	995	620	134	216	1	420	334	192	126	219	

Appendix III.

Key to Symbols used in this Report

Varieties.

A. 220 A. 292 A. 2106	.. .. .. U.4 x Cambodia
A. 332 A. 449 A. 455	.. .. .. U.4 x M.U.8
B. 31	.. A blackarm resistant Upland type from Uganda.
BAR. NT. 96/40 ..	.. NT. 96 carrying B_2 (American Upland).
BAR. NT. 205/43 ..	.. Selected from Uganda SP. 20 and homozygous for B_2
BAR. NT. 205/47 ..	.. Selected from Uganda SP. 20 and homozygous for B_2.
BAR. SP. 84S (BAR.7/3)	.. Material selected by Knight from BAR. SP. 84 for G.O.T.
BAR. SP. 84	.. The blackarm resistant component of Uganda SP. 84.
BAR. 4/5	.. 9th backcross X.1730 homozygous for B_2.
BAR. 4/7=(B31 x 1530^4) x 1730^7	.. 7th. backross X.1730 homozygous for B_2.
BAR. 4/11	.. X. 1730 carrying both B_2 and B_3.
BAR. 4/16=BAR. 4/11 x BAR. $4/7^2$	.. X. 1730 carrying both B_2 and B_3.
BAR. 7/3	.. Selection from BAR. SP. 84 for improved G.O.T.
BAR. 7/8	.. Blackarm resistant SP. 84 carrying B_2 and B_3.
BAR. 14/1	.. 5th. backcross BAR. 2710 x Domians Sakel; homozygous for B_2.
BAR. 14/9	.. 6th backcross of Evelyn's Sakel homozygous for B_4.
BAR. 14/21	.. (J.R. 14/7 x BAR. 14/7) x BLR. 14/16 B_2 B_3
BLR. 14/16	.. Selections for leafcurl resistance made from BAR. 14/7.

BLJR. 14/23	.. Blackarm, leafcurl and jassid resistant Sakel.
BAR. 1730L (XL) ..	.. 7th. backcross X. 1730A homozygous for B_2.
BAR. 1730L. 1 (XL-1)	.. BAR. 1730L which has been "filtered."
BAR. 1730L. 2 (XL-2)	.. BAR. 1730L which has been "filtered."
BAR. NT. 2/41 (B31 x 1530) x NT. 2^7	.. American long staple imported from Barberton.
Domains Sakel (D.S.)	.. A standard variety originally imported from Egypt.
DS1, DS2, DS3 ..	.. Selections and re-selections by Evelyn from Domains Sakel.
Ferguson	.. A hairy Upland obtained from the Phillipines via Trinidad.
JR. 14/5	.. Evelyn's Sakel to which H_1 has been transferred from Tanguis.
JR. 1530	.. Selection from within 1530 for hairiness.
Kapas Purao	.. Densely hairy cotton from India (U.A-7-47).
"L" Cotton (Lambert)	.. The X. 1530—X. 1730 group of cottons, which are resistant to leaf curl.
M.U. 8 b	.. A hairy Upland from India.
NT. 96/40	.. 57 x "Over-the-top," a single plant selection made by Anson.
Pubescent T. 611 ..	.. A mutant, hairy Upland strain from U.S.A.
Pump Scheme Strain (P.S.S.)	Commercial type which originated from Nyasaland Upland.
RDS	.. Leaf curl resistant Domains Sakel.
Tanguis	.. A *barbadense* type imported from Peru.
Wilds No. 11	.. American long staple grown commercially at Zeidab. Large bolled, early.
X. 1530	.. A bushy variety selected by A.R. Lambert from Sakel.
X. 1530 A	.. A successor to X. 1530.

X. 1530 Hairy ..	.. A hairy selection from X. 1530 by H.E. King.
X. 1730	.. A bushy variety selected by A.R. Lambert from Sakel.
X. 1730 A	.. The successor type to X. 1730 at present grown commercially.
X. 1730 F.G. and H.	.. Reselections from X. 1730 A.
XAG	.. X. 1730 A, Gash grown.
XAT	.. X. 1730 A, Tokar grown.
836 840 841 853 857 861 862 891	.. Selections from BAR. SP. 84 made by Rose.

Genes.

B_1	.. A dominant, weak blackarm resistant factor from Uganda B. 31
B_2	.. A dominant, strong blackarm resistant factor from Uganda B. 31.
B_3	.. A strong, partially dominant, blackarm resistant factor from *punctatum*.
B_4	.. A strong, partially dominant blackarm resistant factor from *arboreum*.
B_5	.. Blackarm resistant gene from *barbadense*.
H_1	.. A hairiness gene from Tanguis and MU 8.
H_2	.. A hairiness gene from *tomentosum*.
H_3	.. A hairiness gene from Kapas Purao.

ENTOMOLOGICAL SECTION.

by

R. J. V. Joyce.

I. Staff.

W. S. Richards	..	.. Grasshopper Research
G. Morcos ..	..	.. Biological Control of Jassids
D. G. Pollard ..	..	.. Insecticides.
Bashir B. Shafie	..	.. Pest Control.

II. General Survey of Insect Pests of Crops.

A. Cotton Pests.

Bollworms (various species).

Gezira Scheme. Pink bollworm (*Platyedra gossypiella*, Saund) showed a marked increase over last year's incidence on the whole. Of the areas sampled during the season under review Tayiba and Gezira Research Farm had again most damage, followed by Turabi and Abdel Galil. Incidence at Wad el Bur and Ghubshan was low until February when there was a marked increase. Infestation in the two new western sampling areas, Keteir and Fawar, though sampled one month after the other blocks, was low. The following table shows the sum of the average monthly total of damaged bolls in 6 sampling areas for the last thirteen seasons:—

Season	*Total*
1937/38	43.7
38/39	40.5
39/40	23.1
40/41	38.3
41/42	8.9
42/43	46.3
43/44	16.5
44/45	12.2
45/46	10.2
46/47	9.8
47/48	25.8
48/49	17.0
49/50	22.7

Egyptian bollworm (*Earias insulana*, Boisd) was present in all sampling areas. Its incidence in large bolls was generally lower than in the preceding season.

White Nile Schemes. No boll examination was carried out this season in the White Nile Schemes but Egyptian bollworm was reported in fair numbers at Fatisa and to a lesser degree in all other schemes. American bollworm (*Heliothis armigera*, Hubn) was reported at Dueim.

Northern Province. As in the previous year, damage by pink bollworm at Zeidab showed a marked rise from 1.5 per cent in August to 50 per cent in September. Fortunately the bulk of the crop was picked before this rise in infestation. In October and November the figure dropped to 44.5 per cent and 45.7 per cent.

Damage by Egyptian bollworm was slight. Sudan bollworm (*Diparopsis castanea*, Hamps.) reappeared but inflicted negligible damage to green bolls (1.5 per cent). The American bollworm was absent throughout the season.

Khartoum Province. During June 1949 pink bollworm was common in Shambat Research Farm cotton. Infestation of cotton in privately owned schemes showed a steady rise from 13 per cent in September to 16 per cent in October. A high degree of infestation was recorded during November and December in El Saggai Scheme where damage by pink bollworm reached 63 per cent, and the highest figure for the season was 72.5 per cent infestation during January and February at Tomaniyat Scheme.

Gash Delta. The pink bollworm was first observed all over the Gash in February. The highest percentage of infestation was 3.2 at Hadaliya and the lowest 0.8 per cent at Mitateib, Kassala and Wad Sharefei. This pest was not seen in seasons 46/47 and 47/48. During March 1949 the figure went up to 38.4 per cent at Degein and in April the highest percentage infestation was 62.0 at Tendelai misga 10. Damage by *Earias* to buds and growing points was less noticeable than in the previous season and less shedding of young bolls occurred. The Sudan bollworm was present on all misgas sampled and the highest infestation was 21.0 per cent at Mitateib in April 1949.

Tokar Delta. Bollworms again caused heavy damage to growing points and shedding of flowers and young bolls.

Nuba Mountains. It was the worst season as far as bollworm infestation is concerned. Sudan and Egyptian bollworms made their appearance early in August and continued to the end of the season causing heavy shedding of buds and bolls. The early crop was either completely lost or severely damaged. Losses by pink bollworm were devastating. Infestation was 54 per cent at Kadugli and 35 per cent at Kamina on November 15th. About 30 per cent of the crop is estimated as lost through bollworm damage which was attributed to standing cotton sticks from the previous season.

Abu Habl. Egyptian and Sudan bollworms were common on cotton but caused no serious damage. During October infestation was 5 per cent by Egyptian bollworm and 1 per cent by Sudan bollworm.

Equatoria Province. Bollworms appeared in October causing a certain amount of boll shedding ; the early sown plots suffered less, Pink bollworm was less severe than usual.

Cotton Thrips. (*Hercothrips* spp.).

In the Gezira, attack by *H. fumipennis*, Bagn. and *H. sudanensis*, Bagn. and Cam. was generally light, and only in the southern Gezira did any considerable leaf shedding occur. No serious damage occurred on the White Nile Schemes.

In the Busata Scheme, in the Fung, cotton was heavily attacked by *H. fumipennis* in October causing severe defoliation. The same species caused considerable damage to cotton on the Abu Habl Scheme in Kordofan.

In the Gash the attack by *H. fumipennis* was general throughout the delta, and some patches of cotton were completely defoliated in October but by November the attack had died down. *H. sudanensis* became abundant on early sown cotton in December, and heavy defoliation occurred in patches, usually where the crop had been inadequately watered. Leaf shedding through *sudanensis* continued to spread during January and February.

Experimental plots at Khor Kafai in Kassala Province were severely damaged by *H. fumipennis* in October.

Whitefly. (*Bemisia gossypiperda*, M. and L).

In the Gezira whitefly were far less numerous than usual. In October they occurred rarely on the crop. They were more numerous in November especially in the southern Gezira and in some of the sprayed numbers in the central Gezira. Numbers of adults declined steeply in December.

In the Gash the incidence of whitefly was low on both first and second sowings. Occasional patches occurred, however, where heavy asal had given rise to fungal growth with subsequent severe defoliation.

At Tokar much of the best cotton growing in well watered areas was heavily infested, but damage occurred only in the lee of the dura windbreaks.

Cotton Jassid. (*Empoasca libyca*, de Berg).

In the Gezira infestation was severe and widespread in September and October; the heaviest infestations were generally in Messellemia and Centre Groups although many areas of heavy infestation occurred in the South. North Group generally had the smallest infestation. This is the reverse of what has happened in all previous years when the infestation has been highest in the north. The July-August rainfall was abnormally low in most stations, and some blocks in South Group in fact received less rain than some in North Group. The season's infestation provided striking confirmation of Hanna's rainfall theory.

The peak populations recorded on unsprayed hoshas per 500 leaves were as follows :—

North Group	*Messellemia*	*South Group.*
7,500	16,000	21,000
(Average of 6 fields)	(Average of 8 fields)	(Average of 13 fields).

Damage to unsprayed cotton was very severe.

Heavy infestations occurred throughout the White Nile Schemes and on private pump schemes which are generally sown too late to suffer much damage. Severe jassid damage occurred in the Fung (Busata Scheme) which would normally be considered too far south to be seriously affected.

In Khartoum Province damage to cotton was severe. At Zeidab in Northern Province a fair population of *Empoasca libyca* and *Erythroneura lubiae*, China, was present throughout the Scheme.

In the Gash Delta first sown cotton in all canals showed signs of attack, which was heavy in patches. No serious overall damage occurred, and the second sowings escaped damage. Patches of jassid damage were present at Tokar delta but nothing comparable in intensity or extent to that in the Gezira.

Cotton Aphis. (*Aphis gossypii*, Glover).

Cotton aphis was widespread in the Gezira in February and March causing light asal but nowhere was more than a minor pest. At Tokar numbers were generally low in February, although light asal was present on the best cotton. Numbers increased rapidly in March when it became the major pest in the Delta. It is estimated by the Senior Inspector of Agriculture that the yield in the Delta was reduced by 16000 kantars through the damage of this pest and the complete failure of the rains.

Cotton Stainer Bug. (*Dysdercus* spp).

A small population of both *Dysdercus fasciatus*, Sign. and and *D. superstitiosus*, F. was seen on cotton in the Nuba Mountains. Although the incidence of the first bug was reduced, *D. superstitiosus* assumed greater prominence than usual.

Cotton Capsids.

Helopeltis sanguineus, Popp. was reported in October causing severe damage to cotton plots at Maridi (Equatoria Province).

Creontiades pallidus, Ramp. was again a major cause of shedding in Zeidab (Northern Province) and Tokar Delta. At Zeidab, on the whole its effect was less serious than the previous season. At Tokar much breeding occurred in the dura grown as windbreaks round the cotton and from these centres spread to the cotton when the dura was harvested. Very little breeding occurred on cotton and numbers declined rapidly after the dura harvest. During the few weeks that the bug was present on cotton it was responsible for very heavy shedding of young buds and bolls.

Cotton Flea Beetle. (*Podagrica puncticollis*, Weise).

This season was one of very heavy incidence in the Gezira. Early sown cotton at G.R.F. and Kumor was very severely attacked. Cotton sown in mid-August, adjacent to numbers under cotton in the previous season, was severely damaged in September, especially in the southern Gezira.

In the Gash delta little damage was done to seedlings, but heavy breeding took place on the crop giving rise to severe leaf damage in January and February.

At Kadugli its incidence was severe early in August but the situation was much better by the end of the same month.

Cotton Stemborer. (*Sphenoptera gossypii*, Cotes).

Slight damage by cotton stemborer occurred in the Gash delta during the season. Examination of cotton roots and stalks during May showed a higher incidence of the pest in the first rotation than in the second. There is a big variation between the stations, but Kassala gave the highest with 53 per cent and 43 per cent damage to roots and stalks respectively.

Termites.

As usual Tokar had a severe attack ; on the Abu Habl they caused slight damage to early sown cotton.

Laphygma exigua, Hubn.

It was a serious pest this season in the Gash delta and large areas of cotton of the 2nd rotation in Hadaliya, Metateib, Tendalei and Degein were completely wiped out in September ; and it was rather late for resowing when the attack was over in October.

Cotton Leaf Roller (*Sylepta derogata*, F.)

Incidence of this pest showed an increase on cotton in Kadugli and Hamra during August, but was not very serious.

B. Pests of Dura.

Desert Locust. (*Schistocerca gregaria*, Forsk).

There were no flying swarms in the Sudan during the summer rains of 1949, and breeding up of solitaries during the winter of 1949/50 was on a small scale only. By the end of the period under review (31st May 1950) swarms were appearing in the interior of the country.

Grasshoppers.

In the Gezira large numbers of *Aiolopus savignyi*, Kr. appeared in May, and some breeding occurred in irrigated gardens. In July there were some heavy concentrations on the young dura crop, but, although some damage was done, little resowing was necessary. In

the Fung and Gedaref district this species caused severe damage to seedlings in July in many districts and several resowings were sometimes necessary. In mid-October *Aiolopus* invaded dura in Gedaref district between lat. 14.00 and 13.30 and caused severe damage in some areas to milky grain. In some areas *Catantops axillaris*, Thunb, was also responsible for damage to milky grain.

Dura Stemborer. (*Sesamia cretica*, Led).

The incidence of this pest appears to vary little from year to year. On early sown dura at the G.R.F. there was considerable damage but the main crop of the Gezira suffered relatively little. In Northern Province the stemborer continued to be the worst single pest of dura, which nevertheless gave good yields in spite of heavy infestation. On the M.C.P. Scheme damage to seedlings was only light, and again the incidence on the mature crop was extremely low.

In the Nuba Mountains (Kadugli area) it was severe in the north-western part of the area and moderate elsewhere.

The incidence of dura stemborer in all other dura growing areas in the Sudan was visible but on the whole no serious damage occurred.

Dura Andat. (*Agonoscelis versicolor*, F.)

This pest was rather more prominent than usual during the current season, and damage to milky dura was reported from the southern Gezira and the Fung.

Dura Midge (*Contarinia sorghicola*, Coq.)

Slight infestation on dura heads was noticed in the Gezira Research Farm in September. At Kadugli a few specimens were collected from dura heads in the milky stage during September, and a small scale breeding was evident in October in some localities. It was of no importance in the Abu Habl Scheme this season, doubtess owing to the poor rains.

Other Pests.

An unknown coleopterous larva caused severe damage to seedling dura at the M.C.P. Scheme, boring into the stem just below ground level and eating the growing points. Several resowings were necessary in some areas. The Cetoniid beetle, *Pachnoda marginata*, Dury., did some damage to milky grain in the Gedaref area. *Aphis sorghi*. Theo. was present in most dura areas but was not reported as causing any serious loss.

Birds.

Very few reports of damage by *Quelea quelea aethiopica*, Sund. have been received this season. The Cinnamon Weaver (*Sitagra badius*, Cass.) caused some damage to dura growing near the River Rahad, and the Calandra Eastern lark *Melanocorypha bimaculata*, Menet.) to dura in the Fung. In Northern Province the Sudan House Sparrow (*Passer domesticus arborcus*) took its usual toll from crops growing near villages.

C. Pests of Various Crops.

In the Northern Province lubia suffered heavily from a severe whitefly attack. Jassids (*Erythroneura lubiae*) were also numerous on the same crop. Damage to pods of lubia and Egyptian beans (*Vicia faba*) by American bollworm was normal. About 100 feddans of chick peas at Wad Hamid Basin suffered badly from an attack by greasy cut worm (*Agrotis ypsilon*, Hubn).

The sesame webworm (*Antigastra catalaunalis*, Dup.) attacked young sesame during August and September both on the M.C.P. Scheme and Khor Kafai (Gedaref District). Damage was not serious. The grasshoppers, *Catantops axillaris* and *Catantops joycei*, Dirsch damaged a high proportion of sesame pods. Sesame seed bug (*Aphanus littoralis*, Dist.) was seen at Khor Kafai and on the M.C.P. Scheme but did no damage.

At the end of September, the first sowing of safflower on the M.C.P. Scheme experimental farm was destroyed by larvae of *Heliothis peltigera*, Schif. The safflower maggot (*Acanthiophilus helianthi*, Rossi.) and a safflower bollworm attacked the fruit during December.

At Khor Kafai experimental farm, the black aphis *Macrosiphum solidaginis*, F. was clustering on the fruit and growing points but did no serious damage.

At Khor Kafai groundnuts were severely damaged by *Hercothrips fumipennis*. The attack reached its peak at the end of September and died out by the end of November.

In the Nuba Mountains the attack by sesame webworm was moderate at Kadugli and severe in southern areas. In Kordofan as a whole the sesame seed bug made its appearance towards the end of September and was only severe in some localities during November.

The melon bug (*Aspongopus viduatus*, F.) was an active pest all over the Northern Province.

The continued control measures in Khartoum and Northern Province greatly reduced the incidence of hibiscus mealy bug (*Phenacoccus hirsutus*, Green) and guava mealy bug (*Ferrisia virgata* Ckll) on various trees.

The fruit fly (*Pardalaspis quinaria*, Bezzi.) badly attacked the citrus trees in Shendi gardens.

III. Ecology of the Cotton Jassid (Empoasca libyca).

Field Ecology.

Among the host plants in irrigated gardens on which the cotton jassid survives the dry season, there are some that are much favoured, others on which slow breeding takes place, and others upon which *E. libyca* can support itself for a relatively short time only. The rate of breeding on some of these host plants has been followed in cages and their degree of infestation recorded in the field. The following classification is suggested :—

(a) Primary host plants.

Solanaceae : *Solanum melongena* and *S. dubium.*
Malvaceae : Cotton. Papilionaceae : *Rhyncosia memnonia.*

(b) Secondary host plants.

Solanaceae : *Capsicum frutescens.*
Malvaceae : *Hibiscus esculentus, H. sabdariffa, Abutilon glaucum.*
Myrtaceae : *Psidium guajava.*
Rhamnaceae : *Zizyphus spina-christi.*
Lythraceae : *Lawsonia alba.*

The other plant species on which *E. libyca* has been recorded from time to time appear to be of very little importance as host plants. The status of certain other known hosts—*Helianthus annuus, Cucurbita pepo* (marrow), *Vicia faba* (Egyptian bean), *Ricinus communis* (castor), and *Canna indica* (Canna—flower only) has not been determined, but they may be excluded from the list of primary hosts. Sunt trees (*Acacia arabica*) have been found to support adults only for a few days.

Estimates were made of the population in 9 Gezira gardens in May, June, July, August and September. It was concluded that the population in a garden is determined by the number of primary host plants present. Large jassid populations were never recorded when a garden contained only secondary hosts, although when primary hosts were present these secondary hosts might be heavily infested. The population in a garden was also independent of the rainfall that fell on it.

During July, August and September surveys were made of weed growth in all phases of the rotation in the Gezira. Amongst the wild host plants of *E. libyca* recorded, none played any part in the build-up of population, except *S. dubium, R. memnonia* and occasionally *A. glaucum.* These weeds occurred in July and August throughout the Gezira but especially on canal banks and banks of minor watering channels associated with the dura crop, and inside the dura numbers. These host plants were heavily colonised in July and numbers increased rapidly in August and September. It is suggested that these be called secondary sources of infestation and the gardens primary sources of infestation, since they constitute permanent breeding grounds.

The colonisation of cotton and the development of infestation was followed in 60 observation areas in the Gezira and it is concluded that the most heavily colonised areas are those adjacent to houses and to dura, but that later in the season infestation gradually evens out.

Records from sticky traps and light traps showed that the period most favourable to flight of *E. libyca* was during the second half of July and early August. Records of the incidence of *E. libyca* on *S. dubium* in the Butana (100 miles from the nearest primary source of infestation) and on *S. dubium* and *Cissus quadrangularis* on the Red Sea littoral are regarded as evidence of long range wind dispersal of this species.

It is concluded that control of *E. libyca* may be possible by eradicating primary host plants from gardens from May to November, and destruction of secondary sources of infestation from July to November.

Parasites and Predators.

Previous work by Cowland and Hanna has shown that parasites and predators exercise little effect on the increase in numbers of *E. libyca*. The validity of this conclusion is supported by what can only be regarded as the high natural mortality of adults that has been observed in the field in December, when large numbers could be collected floating on the water in cotton fields under irrigation. A series of experiments were carried out, using the larva of *Aedes aegyptii* as a test insect, to determine whether this mortality was due to the proximity of cotton which had been sprayed with DDT. The results indicated that DDT was not the cause of death. That the lower temperatures in December caused death is an unlikely explanation, especially in the absence of dead nymphs.

Parasitism of *E. libyca* by *Stylops* sp. was reported by Cowland, and by a Dryinid (Hymenoptera) by Michelmore. During the present season investigations have been made to ascertain the distribution of parasitism in the field and to elucidate the factors which limit the breeding of parasites.

The survey revealed in the cotton the presence of the following parasites—*Aphelopus* sp. (Dryinidae, Hymenoptera)—a parasite of nymphs and adults, *Anagrus* sp. (Mymaridae, Hymenoptera) an egg parasite, and an unidentified species (Pipunculidae, Diptera), a parasite of nymphs and adults. Only *Aphelopus* sp. was successfully reared on *E. libyca*.

In the central and southern Gezira Dryinids and Mymarids were found to be widely distributed. Dryinids were more abundant, but the highest percentage of parasitism, recorded in November and December 1949 was 0.8 per cent on the June sowings at Kumor. On August sowings the highest percentage parasitism recorded was 0.3 per cent. In the North Group and on the White Nile Schemes no parasites of *E. libyca* were recorded during the survey. On cotton near the house gardens of the G.R.F. 4 per cent of the *E. libyca* collected were found to be parasitised by *Aphelopus* sp.

Laboratory breeding showed that, on completing its development, the larva breaks through the cyst-like swelling on the abdomen of the host in which it has developed, falls to the ground and pupates in the soil. In the laboratory, successful emergence occurred from well drained sandy soil, but no emergence was recorded from waterlogged clay soil. Since the soil under crop in the Gezira is waterlogged for a considerable part of the cropping season, one explanation of the low degree of parasitism is at once apparent.

Some support for this view was obtained in a survey of parasitism in Tokar and Gash delta, where soil waterlogging does not occur. Preliminary results indicated a considerably higher percentage of parasitism in both places, estimated as much as 20 per cent parasitism by *Aphelopus sp.* in parts of Tokar delta

IV. Ecology of Grasshoppers.

Work on the ecology of grasshoppers in the east central rainlands continued and as in previous years, was centred round the Mechanised Crop Production Scheme (M.C.P.S.) situated near Gedaref in Kassala Province.

It is now established that the grasshopper of major importance is *Aiolopus savignyi*, Kr. Large numbers survive the dry season in soil cracks mainly in dura cultivations infested during the previous season, clustered together at a depth of 18—24 inches. These congregations were recorded only in cropped land growing in the belt of anis, the dominant grass of the M.C.P.S. During the second half of March, *Aiolopus* emerged from cracks on the M.C.P.S. after a light shower of rain. In early May they were abundant throughout the scheme, and were especially common at lights between 15th—20th May. This is taken as an indication of migration. During this period reports of large numbers of *Aiolopus* at lights were received from Gedaref, Kassala, Suki (near Sennar), Wad Medani and Talodi (Nuba Mountains). During May and June, *Aiolopus* was widely distributed throughout the Gezira. On the M.C.P. Scheme they tended to concentrate on roadsides, komodob and burnt areas. Hoppers were observed at the end of June in short grass near Gedaref, in grass in runnels south of Gedaref, on gravel soil at Doka, and in *Acacia seyal* forest near Khor Kafai. In the Gezira hoppers were recorded in considerable numbers in irrigated gardens and along canal banks

Adults were again common in July and caused heavy destruction to seedling dura. These adults disappeared and *Aiolopus* was rare throughout the anis area during August and September. A few nymphs were recorded in short grass areas near Goz Regeb on the River Atbara. Light breeding occurred throughout the Gezira, but heavy breeding was noted on fallow land in the southern Gezira.

In mid-October swarms again became common in the dura cultivation of the anis belt. A tour of the Butana in mid-October revealed a wide distribution of *Aiolopus* in the short-grass belt composed largely of *Heteropogon contortus*. Heavy concentrations of adults were recorded in patches of tall grass such as *Brachiaria obtusiflora*, addar and *Cymbopogon nervatus*. The occurrence of patches of tall grass is a characteristic feature of this short grass belt.

Throughout October *Aiolopus* became more and more prevalent in the dura cultivations of the anis belt, and was responsible for considerable damage to grain in the milky stage. In subsequent visits to the short grass areas in early December very few specimens of *Aiolopus* could be found.

The observations support the conclusions arrived at in previous years that the main summer breeding area of this species is the short grass belt of the Butana, the adults migrating from there in loose swarms in October.

Amongst other grasshoppers of economic importance *Catantops axillaris* caused considerable damage to fruit trees in Gedaref in April; it did not congregate on the dura crop, but, with *Catantops joycei*, caused considerable damage to the pods of sesame in stooks in the field. *Caloptenopsis insignis clara*, Wlk. caused some damage to dura heads which had lodged.

V. Trials of Insecticides.

FIELD COMPARISON OF EFFECTIVENESS OF THREE COMMERCIAL PREPARATIONS OF DDT.

A replicated, randomised experiment was carried out at Turabi designed to compare the increases in yield of cotton obtained by spraying against *Empoasca libyca* with three different proprietory brands of DDT. The following treatments were used :—

Treatment I : Sprayed 17.10.49 with 1 percent D.D.T. Emulsion A.

Treatment II : Sprayed 17.10.49 with 1 percent D.D.T. Emulsion B.

Treatment III : Sprayed 17.10.49 with 1 percent D.D.T. Emulsion C

Treatment IV : Control unsprayed.

Each treatment was replicated 8 times in sub-plots measuring approximately 1/12th feddan, on the standard Gezira rotation. Sub-plots were separated from each other by a belt two metres in width.

Counts of nymphs of *E. libyca* were made at 10-15 day intervals on 20 plant-holes in each sub-plot.

The following is a summary of the counts obtained :—

Yield k.p.f.	Treatment	September			October		November			December.	
		4th	14th	24th	6th	25th	5th	12th	20th	3rd	12th
5.51	I	2.3	5.3	4.7	77.0	14.1	0.5	0.1	0.7	10.0	26.1
5.40	II	2.6	5.5	5.2	64.7	40.0	26.7	6.1	1.1	23.6	47.6
5.61	III	1.5	5.4	6.0	82.1	7.5	0.0	0.2	1.2	8.4	16.7
5.37	IV	3.5	6.4	4.1	75.3	43.8	68.7	10.0	21.2	73.3	220.0

The population as indicated by the nymph counts was fairly evenly distributed before spraying. After spraying high populations were recorded on treatment II, and IV (unsprayed) in the next two counts. In the counts on October 25th the population was fairly evenly distributed in all the sub-plots of these two treatments. In the counts on November 5th in treatment II, over half the total nymphs counted in the 8 replicates occurred on one sub-plot—an edge one. The sub-plots situated in the centre of the experiment supported as few jassids as those of the other treatments. Similarly on treatment IV (unsprayed), on 5th November the highest counts occurred on the sub-plots on the edge of the experiment. This was particularly marked in the remaining counts in November, when the nymph population in the unsprayed plots in the centre of the experiment were as low as those in treated plots.

It is clear that there was much interaction between the treatments which resulted in a reduction in jassid population in unsprayed as well as in sprayed plots. This interaction is reflected in the yields which showed no significant difference between the 4 treatments. The experiment therefore failed.

Laboratory comparisons of the effectiveness of various D.D.T formulations.

Laboratory tests to compare killing power and residual effect of different D.D.T. preparations against the cotton jassid were conducted during January and February 1950.

The method consisted of exposing jassids to sprayed leaves in petri dishes, and noting the mortalities after 24 hours. Leaves were obtained from plants which had been sprayed in the field, fresh selections of leaves being introduced every 5 days, for 40 days. This allows deterioration of D.D.T. under natural conditions, until the time of testing.

Results showed high initial mortalities (100 percent) in all cases, followed by a decline (to 50-80 percent) ; then a rise in killing power after 25 days, (80-100 percent) followed by a final decline.

Wettable powder did not, on the whole, give results as good as emulsion (0.1 percent) except when used at 0.25 percent strength. D.D.T. paste concentrate, (0.1 percent) on the other hand, gave results equal to those obtained with emulsion (0.1 percent).

Experimental errors were numerous in this method and mortalities in controls varied from 10-30 percent. However, with adequate care and attention it should be possible to evolve along these lines a comparatively speedy technique for assessment of gross differences between different formulations.

YIELD INCREASES FROM SPRAYING AT DIFFERENT LEVELS OF JASSID INFESTATION.

In order to obtain some data on the level of infestation of *E. libyca* at which spraying would be profitable, an experiment was laid down at Rukn, in Messellemia Group. The following treatments were adopted :—

Treatment I : Sprayed once
II : Sprayed twice
III : Control : Unsprayed.

The experiment was replicated in 8 cotton numbers, and jassid counts on 100 plant holes were taken on each treatment at 10 day intervals from October until February. The results of this experiment will be given in a separate paper.

THE EFFECT OF D.D.T. SPRAYING ON THE INCIDENCE OF BOLLWORMS.

Observations on the incidence of bollworms were made in the three treatments described in the experiment above. These were made in the following manner :—

Incidence of bollworms in green bolls. A row near to the centre of each treatment was chosen in each of 10 angias and the numbers of plants and bolls per plant hole were counted. From each row 10 green bolls were selected at random for examination.

Incidence of bollworms in sheds. In each of 10 angias in each treatment a square measuring 10 sq. yds was marked out. The shed flowers, buds, and bolls falling into these squares between each watering were collected and examined.

Incidence of bollworms per plant. In each of 4 angias in one of each treatment per number, 5 plant-holes were selected at random (viz 20 plant holes per treatment per number). Each plant-hole was stripped of all buds, flowers, withered, young, and large bolls ; these and the picked skeletons of bolls were bagged separately and brought back to the laboratory for examination.

The incidence of all bollworms in each treatment was low and no clear-cut result was given by any of the methods adopted. Nevertheless although differences in the incidence of bollworms in the treatments are small they are consistent. In December the incidence of damage due to Egyptian bollworm was seven times higher on cotton sprayed once and five times higher on cotton sprayed twice compared with that on unsprayed cotton.

American bollworm was recorded in green bolls only in cotton sprayed once. Pink bollworm only on sprayed cotton. Amongst the sheds of buds, flowers and young bolls, the incidence of Egyptian and American bollworms was again highest on cotton sprayed once. Sheds due to pink bollworm were infrequent in all treatments. During January and the first half of February the incidence of Egyptian bollworm was very low in all treatments and at about the same level. American bollworm ceased to be of importance and the incidence of pink bollworm low but erratic. The differences in infestation by the various bollworms in the three treatments in February, was probably purely accidental.

The collection in February of all flowers, buds, bolls and picked skeletons revealed no marked differences in infestation in any of the treatments.

The results of these observations agree with the findings during the previous season that, when large areas were sprayed, there was a small but definite increase in the incidence of Egyptian bollworm in February on cotton sprayed once, but the increase was insufficient to outweigh the beneficial effect of spraying. In the smaller areas in 1949/50 the higher incidence of Egyptian bollworm on cotton of fields sprayed once could be detected only in December. If this is due to the destruction of parasites in the sprayed fields as was suggested in the previous season it is reasonable to suppose that the infestation by Egyptian bollworm evened out as a result of the recolonisation of the sprayed fields by parasites from the unsprayed.

The findings are also consistent with the results of the general survey of bollworms in the Gezira, where the incidence of Egyptian bollworm was low throughout. No complete blocks were sprayed as in the 1948/49 season, and no marked increase in the incidence of Egyptian bollworm was recorded.

It is concluded that, when the proportion of sprayed to unsprayed areas is low, the danger of increased incidence of Egyptian bollworm as a factor affecting yield is small. The conclusion reached during the previous season that, when the proportion of unsprayed to sprayed areas is very low there is a risk of increased bollworm damage, remains valid in the light of this season's observations.

Trials with an insecticidal fog apparatus.

Through the courtesy of the Sudan Mercantile Company a machine was available from October for trials against various pests. The following trials were made :—

(a) *Against Empoasca libyca on cotton.* These were carried out in October, and after several unsuccessful attempts the following insecticides were applied under conditions extremely favourable for fogging, the fog hugging the ground and drifting between the rows to a distance of about 120 yds. at a speed of about 8 miles per hour. Insecticides were as follows.

(i) D.D.T. emulsion at a rate estimated at 1 lb D.D.T. per feddan, as an oil and water mist (ii) Benzene hexachloride as a wettable powder (as water mist), and as the concentrate YF. 2293 as oil mist at an application estimated at 0.5 lbs gamma isomer per feddan. Poor kills of adults were obtained from all treatments the best being from YF. 2293 as an oil mist. With no treatment was any residual effect detectable and counts of nymphs 3-4 days after treatment revealed only slight reduction in numbers in cotton within 20 yds of the place of application and no reduction beyond that. Application of insecticides as a fog was definitely inferior to application as a spray.

(b) *Against Aiolopus savignyi on dura.* The insecticides used were Agrocide Wettable Powder and the B.H.C. concentrate YF. 2293. There was no evidence of any decrease in population after treatment, and no dead grasshoppers were found. It was concluded that under the conditions obtaining the fog drifted too far and, under conditions of high ground temperature, rose too quickly.

(c) *Against the dura andat bug* (*Agonoscelis versicolor*). Cold spray and water-borne mists of D.D.T. emulsion (at 0.5 per cent and 1 per cent); D.D.T. wettable powder (at 2 per cent); liquid Agrocide 3 (at 0.1 per cent gamma isomer) and a pyrethrum solution in paraffin (2.5 per cent pyrethrum) were applied to bugs aestivating on trees. Good knock-down was achieved only with the pyrethrum-paraffin mixture but promising results were obtained with liquid Agrocide 3. 100 per cent kills occurring in the test samples. Difficulty in controlling application was experienced.

VI. Control of Pests.

Locust campaign.

The few desert locust hoppers that emerged on the Red Sea coast around Suakin and Agwatire in February 1950 and the succeeding emergence in March at Khors Eigaiet, Dahrab and Arbaat were successfully dealt with. The outbreak was on a small scale only.

Pink bollworm.

Routine inspections of ginneries in the Gezira and the Nuba Mountains were carried out to ascertain freedom of used cotton sacks from seed cotton.

Sunning of cotton seed as a control measure against resting larvae was carried out at Zeidab, Tokar, Khartoum and the Nuba Mountains.

The usual inspection of riverain cultivation in the vicinity of the Gezira scheme was done in June and August to ascertain that bamia was not growing during the dead season. Illegal bamia was dealt with by the police.

Cotton flea beetle.

In the Gezira Scheme dusting continued from 10th August up to 21st. September. 2898 Kg. of Agrocide 3 were used over an area of 4508 feddans. The infestation was heaviest in Wad Shair, Wad Hussein and Hag Abdalla Blocks, heavy in Hamad El Nil, Abdel Galil and Amara Kasir and fairly heavy in Kumor, Ghubshan, Wad El Attaya, Darwish, Remeitab and Barakat. Measures were successful, but with the one machine available, only a limited area could be treated.

At Kadugli dusting flea beetles with D.D.T. at weekly intervals on the Kamina Farm was a success.

Cotton stainer bug.

As usual the population of stainer bugs on tebeldi trees (*Adansonia digitata*) in the Nuba Mountains was sprayed with paraffin, and Agrocide wettable powder had a successful trial. Two campaigns were carried out in Kadugli area one during the period 1st April—1st. May and the second from June 12th. to August 18th.

Dura andat bug.

Destruction of this pest was carried out in the usual way by shaking the trees and sweeping the bugs on to the ground and covering with earth. Control measures were done in Rufaa District, Gedaref District and in the southern Gezira.

Mealy bugs.

Campaigns against mealy bugs were carried out in Khartoum and Northern Provinces. The normal procedure of pruning off the heavily infested shoots and burning them and then spraying the trees with Volck was followed this season.

Field rats.

Minor campaigns were performed in Shendi District against field rats. Successful results were achieved by using zinc phosphide bait.

Birds.

No control operations were necessary against *Quelea* in the eastern area this season. Scouting was continued in the Atbara, Rahad, Dinder and Blue Nile areas until November when scouting supervisors were moved to the White Nile between Kosti and Malakal.

VII. Observations and Minor Experiments.

Emergence of pink bollworm moths from the resting stage at Shendi.

Open bolls were caged in November. Emergence was as follows:—

Month	1948/49			1947/48		
	PBW	EBW	SBW	PBW	EBW	SBW
November 48	73	51	—	5,530	—	—
December	13,032	581	1	1,244	—	—
January 49	12	—	1	203	—	—
February	3	—	—	89	—	—
March	18	—	—	116	—	—
April	21	—	—	79	—	—
May	29	—	—	42	—	—
June	—	—	—	14	—	—
July	—	—	—	7	—	—
August	4	—	—	18	—	—
September	1	—	—	3	—	—
October	—	—	—	—	—	—
November	—	—	—	—	—	—

The few long cycle moths which appeared from July onwards presumably formed the nucleus of the heavy infestation which took place in September and October.

VIII. Plant Quarantine Service.

LEGISLATION DURING THE YEAR, RESTRICTIONS OF INFESTED AREAS AND ERADICATIONS OF PROCLAIMED DISEASES.

Legislation.

The Growing Plants (Northern Province) Export Order 1949 was officially published in the Sudan Government Gazette No. 806 of 15th August 1949 (1949 L.R.O. No. 72).

Eradication of Proclaimed Diseases.

Khartoum Province. General inspection of the fruit gardens was carried out during the period 4th—17th. April 1949 and a separate report on the mealy bug and scale insects situation was circulated to the authorities concerned. The inspection of house gardens during the period June—August was conducted.

Northern Province. The inspection of fruit gardens in Shendi and Gendettu areas and also the necessary control measures against mealy bugs were conducted by the Entomological Staff at Shendi. The monthly inspection and necessary treatment against mealy bugs and scale insects at Wadi Halfa were organised by the Plant Quarantine Officer.

Port Sudan. The control measures against mealy bugs and scale insects in Port Sudan house gardens were carried out by the Plant Quarantine Staff.

The pruning and burning of the infested parts and spraying with Volck-Agral solution were successfully applied in each case and found to be effective in keeping the spread of mealy bug and scale insects in check.

EXAMINATIONS.

6548 consignments were presented and dealt with at the three Plant Quarantine Stations (Khartoum, Wadi Halfa and Port Sudan) during the year under review as compared with 4584 consignments in 1948.

1947	1948	1949	
1,271	2,314	4,497	Imports
1,654	2,184	1,894	Exports
144	86	157	Local
3,069	4,584	6,548	Total

In addition to the above mentioned, and with the cooperation of the Customs officials, there were 472 consignments imported through the following Customs stations as compared with 342 consignments in 1948.

27	Consignments	through	Basunda
174	,,	,,	Geneina
180	,,	,,	Juba
7	,,	,,	Kassala
46	,,	,,	Kurmuk
4	,,	,,	Malakal
34	,,	,,	Roseires
472	Total		

DISINFECTIONS.

Owing to the infestation with proclaimed diseases, store pests etc. 334 consignments were treated before release (as compared with 333 consignments in 1948 and 192 in 1947).

Plant Import Permits.

89 permits allowing the import of living plants of plant products from other countries were issued during the year as compared with 75 permits issued in 1948.

Seizure by Customs.

Owing to infringement of the regulations 5 consignments were seized by Wadi Halfa and Port Sudan Customs.

Refusal of Certifications (9 consignments).

Certification of 2 consignments at Wadi Halfa was refused for the presence of *Ephestia* larvae in a consignment of dates and unvalidity of the steam sterilization certificate for bedding materials and 7 consignments at Port Sudan were not certified owing to the presence of Bruchid beetles and pink bollworm in sunt pods and cotton seed respectively.

Confiscations, destructions or re-exports. (4 consignments).

Wadi Halfa. One sack weighing 7 Kg. of ginned cotton contaminated with cotton seed from Egypt was destroyed by fire.

Port Sudan. 5 plants in pots imported from Egypt were destroyed owing to the absence of Plant Import Permit. 3 pillows from India were found to contain cotton seed, and were destroyed. Five baskets of pomegranates weighing 125 Kg. imported from Cyprus were destroyed by Public Health authorities as being unfit for human consumption.

Revenue.

The revenue of the Plant Quarantine for the year 1949 considerably increased amounting to £E. 1,006.945 m/ms. as compared with £E. 504.035 m/ms. in 1947 and £E. 848.900 m/ms. in 1948.

SOIL RESEARCH SECTION

by T. N. Jewitt, T. A. Jones and K. R. Middleton.

1. Introduction.

Our main lines of work have been much the same as last year. Pedological studies have been made in the Tokar Delta, and in Yambio District. Dr. Jewitt spent a month in Jordan, mainly studying the soils of the Azrag depression. Work has continued on toich samples from the Yirrol Toiches and on samples from the Aliab Valley. Detailed study of organic nitrogen in the Gezira has continued and a very large number of determinations of organic carbon have been made on the same soil by the Walkley-Black method. A study of field nitrates in the Three Course Rotation Experiment has been prpared for publication. Some work has been done in collaboration with the Plant Physiology Section on the mineral composition of cotton leaves.

2. Meteorology.

The usual supervision of the seven Gezira stations has been continued. Data for the Gezira Research Farm for the crop year 1949/50 are given on p. 111. As an appendix to this report the monthly rainfall data for the Gezira Research Farm are given from 1919 to 1949 inclusive.

3. Soil Reconnaissance and Survey.

A. Blue Nile Province (White Nile Area).

Two large areas surveyed last year have been reported upon, as well as a third done this year.

(a) *Khor Abu Gassaba.* Eighty eight holes gave the followin frequency distribution for sodium values.

Sodium Value	N. of Holes
0-10	10
11-15	21
16-20	17
21-25	10
26-30	9
31-35	9
36-40	6
41-50	3
51-60	3

This is a favourable distribution, and the area will be developed at least in part. The sodium value is mg.e of exchangeable and soluble sodium per 100 g. clay.

(b) *South of Kosti* (*West bank*). This area gave the following distribution of sodium values.

Sodium Value	N. of Holes
0-10	23
11-15	14
16-20	17
21-25	18
26-30	9
31-35	1
36-40	1

It is our view that distributions which differ so radically as these two, indicate that the soils should be differently classified. At the moment all the soils along the White Nile are regarded as members of one widely variable group.

B. Blue Nile Province (East Bank of Blue Nile).

A considerable reconnaissance survey has been done on the east bank of the Blue Nile. Some 450 holes have been dug. Some of the soil ressembles Gezira soil, but further inland there are large areas of soils more like those of Ghadambaliya (See 1948,49 Annual Report).

C. Equatoria (Aliab Valley).

A number of holes were dug by a collaborator during survey work in this area, which is one of those affected by the proposed Jonglei Canal. The following table gives data for three of these soils :—

Table II.

Foot	S.G. %	C.S. %	F.S. %	Silt %	Clay %	Na Value	pH.	N. p.p.m.	Exch. Ca.
1	0	43	27	3	26	1	8.67	410	6
2	1	44	23	2	29	0	8.30	237	7
3	1	38	23	7	31	0	8.46	269	nd
4	1	43	22	4	29	0	8.40	177	nd
5	1	45	25	3	25	0	8.37	237	nd
6	7	45	22	3	23	0	8.50	145	nd
1	0	62	24	5	8	0	5.85	235	2
2	0	61	20	3	15	0	5.15	275	2
3	0	58	15	3	24	1	5.25	275	nd
4	2	48	14	3	32	2	5.25	280	nd
5	0	27	22	4	48	1	5.50	250	nd
6	1	29	22	5	43	4	5.60	170	nd
1	0	1	38	13	48	3	6.10	2570	9
2	0	0	66	8	26	6	7.35	480	5
3	0	0	20	16	64	6	7.55	515	nd
4	0	1	79	6	13	1	7.10	170	nd
5	0	2	55	7	35	1	6.90	550	nd
6	0	0	33	15	52	0	6.80	650	nd

It is evident that the soils vary very considerably. The sodium values are small compared with those found in the Northern Sudan, but so also are the exchangeable calcium figures. It appears very likely that some of the soils will have a low permeability. The second step of the third soil listed above has ratio of exchangeable calcium to exchangeable sodium of only about 3 : 1. The sodium values quoted above are mg.e. of sodium per 100 g. clay.

4. Soil Nitrates.

The results of long-continued measurements of first foot soil nitrates in the Three Course Rotation Experiment have been reviewed.

The correlation coefficients for the mean August and September soil nitrates with the rainfall from July 1st. to August 15th. pre-sowing rain have been calculated. The results for the period 1934/35 to 1947/48 are as follows :—

Rotation	Correlation Coefft.
I CFF	—0.83
II CDF	—0.58
III CDD	+0.47
IV CLF	—0.59
V CDL	—0.18

The levels for P=0.05 and P=0.01 are 0.53 and 0.66 respectively. The rotations nearest to the commercial one are I and IV. The negative correlation with presowing rain is strong evidence against increased nitrate at sowing time being the explanation of the beneficial effects of heavy presowing rains.

The distribution of nitrate in the upper two feet of soil was measured at a number of times during the rains and afterwards. As in previous years there was strong evidence for the leaching of nitrates from the surface soil during the rains and early irrigations. In this year of very light presowing rains very high values of nitrates were determined at sowing time. The table below gives the detailed results for successive 6″ step to 2′ in p.p.m. NO_3 nitrogen in oven-dry soil.

Step.	May 18th.				June 19th				July 16th				August 12th				September 11th			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Rotn.																				
I	9	6	7	5	10	8	7	7	8	7	5	5	9	8	10	20	8	3	1	4
II	8	7	3	2	10	9	6	4	9	7	5	4	14	6	9	12	10	2	2	4
III	1	1	2	3	1	1	1	1	1	1	1	1	4	3	3	3	3	1	1	1
IV	12	11	10	7	18	18	12	10	17	17	12	10	17	12	16	27	18	3	2	5
V	3	2	2	2	3	4	2	2	3	3	3	2	10	5	9	9	7	2	3	6

5. Yirrol Toich Catena.

The area studied is the flood plain of the river Lau between Ngop in the south and Lake Neubor in the north, and represents toich country near its junction with the ironstone soils. The whole area measures about 50 miles from north to south and about 30 miles across at its widest point. It narrows to about 5 miles across in the south where it is bounded by low ironstone hills. Similar formations bound the area on the east and west. In the north it passes into permanent swamps. The general slope is from south to north and from west to east. The Lau, which is the main drainage channel, flows along the eastern edge. In times of spate it has an additional course called the Jau which passes through localized swampy areas on its way to Lake Neubor. The topography generally is flat or very slightly undulating.

The superficial deposits which provide the parent material for the soils of the area are concretionary ironstone capping the hills and heavy clay alluvium derived from it and from the weathering basement complex of the distant Nile-Congo watershed. These soils have already been provisionally classified by Greene as forming a Toich Catena.

The following five different types have been recognised :—

1. *The Lateritic Ironstone Soils.*

This type occurs generally in the most elevated positions and is the zonal soil of the area. The drainage is free but there is nevertheless considerable sheet erosion, as well of course as mechanical and chemical eluviation during the wet season, and the parent material is weathered to great depths. The vegetative cover is Broad-leafed Woodland giving way to Acacia-Tall-Grass Forest. The surface soil is a red-gray sandy loam containing small lateritic gravel and this overlies compact reddish-brown clay mottled near the top and streaked with yellowish tinges at depth, also with accumulations of lateritic gravel, particularly on top.

2. *Colluvial Soils.*

These occur immediately below type 1 which they resemble in appearance and vegetative cover. They are composed of materials mechanically derived from above but are generally heavier and less stony and have an appearance of greater fertility.

3. *Vlei Soils.*

These are soils derived from colluvial and illuvial materials and are found in juxtaposition to 2. but in local depressions. Their later development has been dominated by the nearness to the surface of the ground water and they form semi-swamp areas. The surface soil is a dark reddish brown sandy loam and the lower layers contain calcium carbonate concretions.

4. *Toich Soils.*

These are all seasonally flooded soils which mostly dry out completely in the dry season. They are usually red-brown at the surface, streaked and mottled with depth sometimes with a yellowish tinge. They are usually heavy alluvial clays with illuvial additions from the local water shed, but in some cases there is an underlying sandy layer which permits the overlying material to drain well. In most cases, however, there is evidence of impeded drainage. All have a rather high permanent water table and there is generally the appearance of a glei horizon.

5. *Riverain Soils (Alluvial).*

These constitute the raised banks of the river and are somewhat variable in appearance. They may be a light red-brown loam over red-brown clay or a light purplish-grey sandy-clay with a uniform appearance in depth. The vegetative cover is tall grass and occassional trees. These soils are seasonally flooded.

Analytical Data.

For steps larger than 12 " the figures quoted in Table IV are the average for the step, and are on air-dry basis ; average moisture figures for the separate holes are given in the last column. The holes are representative of the types given above as follows :—

Hole K=Ironstone,

Hole I =Colluvial,

Hole E=Vlei,

Holes 1 and 6=Toich

Hole C=Riverain.

TABLE IV.

Hole	Step	pH	Salts mg %	Ca me. %	Ex. Ca me %	Ex. K me %	Ex. Na me %	P_2O_5 mg %	Carbon mg %	N mg %	Clay %	Silt %	Sand %	Stones %	H_2O %
K	0—12	6.4	21	5.1	—	0.17	0.17	33	350	27	7	2	83	8	
	13—30	6.0	25	3.8	—	0.17	0.23	19	270	25	10	3	63	59	0.9
	31—84	5.7	11	1.3	—	0.39	0.28	3	100	16	20	4	49	28	
E	0— 7	6.0	24	3.6	2.8	0.74	0.28	14	500	48	9	2	83	6	
	8—25	7.2	33	8.6	2.7	0.53	0.14	15	180	27	32	2	61	5	2.3
	26—60	8.0	48	16.5	4.9	0.50	0.41	10	160	21	38	4	55	2	
I	0—12	5.8	31	6.0	—	0.20	0.07	17	690	39	30	3	65	1	
	13—60	6.1	15	5.9	—	0.27	0.28	6	200	19	35	3	60	3	1.7
C	0—12	5.3	22	7.8	7.8	—	—	73	840	85	51	12	37	—	
	13—72	7.1	29	15.2	10.5	—	—	102	210	25	51	9	40	—	2.5
1	9—12	5.9	24	10.4	9.2	0.44	0.78	13	1130	120	72	6	22	0	
	13—72	6.9	24	7.0	5.9	0.19	0.57	9	140	25	54	4	41	1	3.2
6	0—12	5.6	17	11.3	10.5	0.74	0.64	67	810	89	77	17	6	0	
	13—24	5.8	20	13.9	13.0	0.52	0.94	59	1130	144	88	17	5	0	
	25—36	5.9	17	12.6	10.2	0.46	0.82	64	580	48	68	16	16	0	4.6
	37—48	5.8	16	15.6	12.3	0.41	0.81	27	1010	99	27	8	15	0	
	49—60	6.3	19	4.0	0.7	0.21	0.51	27	220	13	57	4	48	0	

Description of Profiles.

Hole K. This is a much-leached, slightly acid profile. The type of weathering is considered to be lateritic and the eluviated materials have been lost to the ground water. Except for some accumulations of clay in the lower layers there is no sign of an illuvial horizon. The base status is extremely low, expecially in the lower layers. There is, surprisingly, a relatively high phosphate content in the top foot. Organic carbon and nitrogen are very low. The ability of this type to support a natural vegetative cover is surprising but its agricultural potentialities are obviously very low.

Hole I. There is a general resemblance to K on a slightly higher level of fertility. The profile is less stony and there is more clay. Potentialities should be greater. Surprisingly the general phosphate level is lower than for Hole K.

Hole E. The parent material is of similar origin to Hole 1 and differences are attributable to high ground-water level. This is brought out by the difference between the total and exchangeable calcium figures and the increase of pH with depth, with the associated presence of calcium carbonate.

Holes 1 and 6. These are representative of the toich lands proper and are subject to seasonal flooding. The pH increases with depth and the base status is comparatively high. They all contain very large amounts of clay. Hole 6 is interesting because of the evidence of layering which is a characteristic of alluvial soils generally, but not often observable in these types.

Hole C. This is a more silty and less sesquioxidic type as compared with the foregoing types. Notable differences are higher base status and very much higher phosphate figures. It suffers periodic flooding and the pH markedly increases with depth. The formation of calcium carbonate concretions was not observed.

Note. The exchangeable bases given in Table IV are obtained using N/2 acetic acid for extraction with carbonate determined separately. Calcium and phosphate were extracted with boiling 50 per cent nitric acid and are considered effectively total.

6. Analysis of Cotton Leaves.

This investigation was carried out in collaboration with the Plant Physiology Section who did the sampling.

The cotton plants of the five three-course rotations were sampled on 24.9.49. The following table gives the oven dry weight of the leaf samples (20 plants) and the percentages of nitrogen, P_2O_5, K_2O and CaO in each sample on oven-dry basis.

Rotation	Replicate	Wt of Sample	percent N	percent K_2O	percent P_2O_5	percent CaO	Final yield
		g					*kpf.*
I CFF	1	11.6	3.07	2.95	0.94	5.70	3.78
	2	11.0	3.09	3.20	0.94	5.65	3.60
	3	10.0	2.89	2.85	0.67	5.66	3.44
	4	11.2	3.44	2.89	0.84	5.14	3.52
	mean	11.0	3.12	2.97	0.85	5.54	3.59
II CDF	1	23.2	3.81	3.28	0.95	5.45	3.77
	2	16.0	3.94	2.93	0.83	5.69	3.62
	3	17.8	2.86	3.05	0.91	5.67	3.94
	4	14.2	3.34	3.12	0.93	5.59	3.60
	Mean	17.8	3.49	3.09	0.90	5.60	3.74
III CDD	1	19.4	3.23	3.10	0.93	5.52	2.55
	2	17.3	3.47	3.38	1.06	4.98	2.36
	3	11.5	3.08	2.96	0.98	5.19	2.69
	4	16.5	3.13	2.94	1.17	5.41	2.62
	Mean	16.2	3.23	3.10	1.03	5.27	2.55
IV CLF	1	19.4	3.38	3.20	1.05	5.78	4.17
	1	14.7	3.32	3.10	0.86	5.66	4.17
	3	12.8	3.78	3.07	0.77	5.76	3.90
	4	14.0	3.34	3.11	0.73	5.64	4.32
	Mean	15.2	3.45	3.12	0.85	5.71	4.13
V CDL	1	21.7	4.15	3.34	0.94	6.04	4.37
	2	20.2	3.45	3.24	0.83	6.15	3.97
	3	19.2	3.72	3.11	0.74	5.77	4.30
	4	19.5	3.43	3.24	0.87	5.83	3.98
	Mean	20.15	3.69	3.23	0.85	5.95	4.16

This year within the replications of each rotation there was considerable variation in percentage nitrogen, last year in a similar experiment this was not the case. There appears to be a positive correlation between mean CaO percentage and final yield of the rotations, the same sort of relationship was evident in last year's results. Comparison of these figures with the appropriate field nitrate levels in Table IV shows no interesting associations. It will be noticed that the total nitrogen in the leaves of the rotation III samples is not strikingly lower than in the other rotations, in spite of very much lower field nitrate levels during August and September.

7. Carbon Dioxide from Gezira Soil.

The carbon dioxide evolved from the moist soil is collected in 0.1 N Na OH in a closed flask and determined by back titration. The table below gives progressive daily totals of CO_2 production from 50 g. air-dry soil with 40 per cent of added water. The soils are first foot composites of the five different rotations of Plots 12 and 13. They were sampled on 12.8.49, before sowing with cotton. The CO_2 is given as equivalent ml. of 0.1 N Na OH.

Rotation	CFF I	CDF II	CDD III	CLF IV	CDL V
Days					
1	0.41	0.38	0.26	0.30	0.30
2	0.77	0.76	0.46	0.64	0.61
3	0.98	1.04	0.64	0.82	0.89
5	1.48	1.57	0.98	1.29	1.43
7	1.81	1.98	1.38	1.70	1.89
9	2.23	2.34	1.78	2.10	2.39
11	2.51	2.67	2.08	2.40	2.66
14	2.83	3.10	2.47	2.81	3.18

The 14 day totals for similar samples taken last year were:

1.85	2.08	2.52	2.25	2.92

It is noticeable that the rotations I, II and IV, where cotton follows fallow, show larger evolutions this year. It will be remembered that the rainfall in 1949 was unusually low.

8. Organic Nitrogen in Gezira Soil.

In last year's report on this subject the changes in organic nitrogen during two season were described. These two seasons showed quite different changes in organic nitrogen. Season 1946/47 was characterised by large gains in nitrogen, 1947/48 showed a considerable net loss. Further work has shown another different pattern of changes involving little net change throughout the next season.

The larger changes in soil nitrogen have been examined in the light of seasonal changes of climate. It appears that active fixation occurs during the rains. The period October 1946 to April 1947 during which extensive fixation occurred, is associated with a succession of months with average monthly maxima well below the long term averages. This was not due to a small number of days with abnormally low temperatures. Relative humidity (8 a.m.) figures were well above average. The nitrogen loss period of 1947/48 was associated with the reverse of these conditions. The months July to October had extended periods of high temperatures. Humidity figures were fairly normal.

During 1949/50 the cotton phases only of the Three Course Rotations have been sampled. The season so far has shown a surprising absence of fluctuations, and a steady fall in nitrogen. Some rotations of the Combined Rotations Experiment have been sampled, and they too have shown only small changes. The actual levels of organic nitrogen in these plots is lower than in the Three Course Rotations. There is no doubt that the Combined Rotation Experiment is on less fertile land than the Three Course plots.

9. Rain Dura Lands.

KORDOFAN PROVINCE.

Moisture sampling was continued in the Abu Habl area. It was shown last year that differential flooding influenced soil moisture nearly four months later and after cropping. It was later found that land which had been flooded for the 48/49 season but not cropped had a higher moisture content a year later than areas comparably treated but cropped in that season. The following figures show the extent of the difference on 29.8.49.

Moisture Percentage O.D. basis.

	Ft. 1	Ft. 2	Ft. 3	Ft. 4
Cropped areas	16	17	25	24
Discarded areas	23	21	35	33

Experiments using such areas are described on page 119 of this report.

The differential watering experiment was repeated this year and the following figures give the results for the 20 days and 15 days flooding.

TABLE X.

Moisture Percentage O.D. basis.

20 days flooding	Ft. 1	Ft. 2	Ft. 3	Ft. 4
Before sowing	48	39	29	29
After 49/50 Cotton	11	18	22	17
After 49/50 Dura	11	13	20	17
After 49/50 Fallow	37	33	33	28
15 days flooding.				
Before sowing	41	25	29	23
After 49/50 Cotton	6	12	21	21
After 49/50 Dura	15	16	12	16
After 49/50 Fallow	32	29	26	18

It is evident that flooding without cropping leaves considerable moisture in the soil some four months later.

KASSALA PROVINCE.

The result of soil moisture determinations on the fallow-discing experiment at Ghadambaliya are give on page 113. It is evident that discing at the proper times in the year before cropping resulted in moisture conservation and increased yields.

10. Miscellaneous.

Jordan.

Some 200 profiles were examined and sampled. The bulk of them in the Azraq depression, east of Amman, the others were from the plateau southwards from Amman to Akaba. The latter were mostly profiles in situ on a variety of carbonate rocks. The Azraq depression is extremely saline with very saline subsoil water within a few feet of the surface. Some fringing areas are heavily gypsiferous.

Dyeing of Cotton Seed.

The work described last year has been completed and the whole of 1950/51 Sakel sowing seed of the Gash has been treated with 0.1 per cent of Congo Red. The dye was applied mixed with the Abavit dust. Congo red was selected because it has no effect on the bactericidal quality of the Abavit. Certain dyes reduce the effectiveness of Abavit dust against blackarn disease, and caution is necessary when using dyes to distinguish cotton seed, if seed dressings are also being used. An unexpected result of sowing dyed seed was that the dye was readily observable on the cotyledons of the young seedlings.

Growth of Young Cotton Seedings.

In last year's report experiments were described which suggested that competition for an oxygen supply limited by gaseous diffusion might be important for the early growth of cotton roots. This has been tested by observing the growth of young roots in thin layers of soil under an atmosphere of 50 per cent oxygen. No important differences in rate of growth resulted from this treatment. The effect of enriching air with carbon dioxide has not yet been tried.

Plot 57.

A number of profiles on this plot were examined and sampled and compared with the adjacent Plot 58 which has been on the same basic rotation but without the annual ammonium sulphate and which has not shown the same loss of fertility as 57 seems to be showing.

Examination of the profiles showed no unusual features and neither did pHs., salts or nitrates.

G.R.F. WAD MEDANI.

MONTHLY RAINFALL (CORRECTED LIST) m/ms.

Year	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Total.
1919	—	—	—	9.7	149.1	108.9	64.2	13.8	—	345.7
1920	—	—	0.2	42.4	112.8	309.9	88.1	2.1	—	555.5
1921	—	—	—	22.2	82.1	147.0	69.4	3.0	—	323.7
1922	—	—	6.2	12.2	212.8	251.1	79.1	6.4	—	567.8
1923	—	6.6	32.2	18.0	250.9	92.4	34.4	—	2.7	437.2
1924	—	—	—	73.9	25.9	156.9	77.7	7.5	—	341.9
1925	—	—	2.0	53.3	92.4	61.2	42.2	22.8	5.2	279.1
1926	—	—	22.7	6.0	131.7	47.0	23.5	7.0	1.8	239.7
1927	—	—	1.5	16.9	108.7	119.0	116.3	0.5	—	362.9
1928	0.2	3.0	9.2	8.6	51.6	196.3	47.9	2.4	—	319.2
1929	—	12.2	25.9	43.9	351.3	184.5	85.5	4.0	—	707.3
1930	—	—	0.8	82.8	117.9	146.0	46.6	8.0	—	402.1
1931	—	—	—	1.7	111.7	107.7	87.3	28.0	—	336.4
1932	—	0.5	1.5	70.0	72.5	190.5	74.7	14.2	—	423.9
1933	—	—	30.6	34.5	80.5	117.1	52.0	36.0	1.0	351.7
1934	—	—	4.0	67.2	174.9	93.0	41.5	—	—	380.6
1935	—	23.0	15.6	26.3	71.2	123.5	38.7	26.9	—	325.2
1936	—	1.8	19.3	54.3	98.3	207.4	48.1	26.2	—	455.4
1937	—	7.5	37.1	26.5	238.7	73.8	57.4	2.0	15.0	458.0
1938	—	—	1.0	—	134.4	170.4	48.1	2.5	—	356.4
1939	—	16.1	16.4	60.1	234.4	129.1	50.3	43.4	—	549.8
1940	—	7.9	7.5	59.9	85.3	113.3	15.9	9.7	—	299.5
1941	—	—	18.9	6.5	85.7	149.6	6.2	12.4	—	279.3
1942	—	—	15.8	—	119.2	189.1	9.9	40.2	—	374.2
1943	—	—	6.0	8.4	88.6	135.7	50.0	22.2	5.4	316.3
1944	6.2	11.0	—	28.0	290.6	83.9	38.8	18.4	—	476.9
1945	—	—	38.5	9.8	47.9	95.1	44.3	16.5	—	252.1
1946	3.9	—	1.3	29.9	159.6	125.6	86.7	17.9	—	424.8
1947	—	—	48.8	22.1	46.7	97.6	27.9	7.2	—	250.3
1948	—	—	20.3	70.3	150.5	97.1	97.3	11.1	—	446.6
1949	—	—	50.0	36.7	48.1	47.4	57.2	8.0	—	247.4
Average 1919/49	0.3	2.9	14.0	32.3	129.9	134.4	55.1	13.6	1.0	383.4
Average 1919/42	—	3.3	11.2	33.2	133.1	145.2	54.1	13.3	1.1	394.8

EXPERIMENTS AT THE MECHANISED CROP PRODUCTION SCHEME—GHADAMBALIYA.

by

Zain El Abdin Abdel Nabi.

I. Fallow Discing Experiment.

In 1948 season a replicated and randomised plot was laid out for a fallow discing trial for cropping in 1949. Eight cultivation treatments were operated as below.

Treatments.

The details of treatments are :—

Treatment — *Details of Discing* (1948).

I — Two early discings.
II — One early and one medium discing.
III — Ditto.
IV — Disced twice and sown dura on 29/8/1948.
V — One medium discing and one late cultivation.
VI — Ditto.
VII — One-way disc tiller.
VIII — Untreated—no discing.

Table I shows the actual discing dates.

Table I.

Treatment	Dates of Discing (1948)				
	Block I	Block II	Block III	Block IV	Block V
I	8–16/7 1– 5/8	8–16/7 1– 5/8	8–16/7 1– 5/8	8–16/7 1– 5/8	8–16/7 1– 5/8
II	8–16/7 28–29/8	8–16/7 11–16/8	8–16/7 28–29/8	8–16/7 11–16/8	8–16/7 11–16/8
III	8–16/7 28–29/8	8–16/7 11–16/8	8–16/7 11–16/8	8–16/7 5/8	8–16/7 5/8
IV	Disced twice and sown dura on 29/8/1948				
V	1– 2/8 13–14/9	1– 2/8 13–14/9	1– 2/8 13–14/9	11–16/8 13–14/9	28–29/8 13–14/9
VI	28–29/8 13–14/9	28–29/8 13–14/9	28–29/8 13–14/9	11–16/8 13–14/9	11–16/8 13–14/9
VII	14–15/9	14–15/9	14–15/9	14–15/9	14–15/9
VIII	No cultivation.				

The western half of all treatments (with exception of treatment IV, which was under crop) was finally double disc harrowed on 2-5/11/1948.

Soil Moistures.

Soil samples for soil moisture content determination were taken on 23-24/10/1948 and 16-17/4/1949. A summary of the means is shown below :

Table II.

Showing percentage soil moisture content.
Means of 4 replications from each treatment.
One sample from each replication at each date.

		West—November discing					*East*—not disced in November				
Sampling Date	Treatment No.	0–6″	6-12″	2′	3′	4′	0-6″	6-12″	2′	3′	4′
23 24/10/48	I	24	27	26	25	26	28	31	32	29	26
	II	30	33	32	31	30	28	31	32	34	28
	III	26	29	31	29	27	25	29	29	28	26
	IV	29	31	32	27	25	28	32	21	27	27
	V	33	36	36	31	28	35	36	27	33	28
	VI	34	37	35	29	29	32	35	36	31	27
	VII	30	34	31	26	26	31	33	26	23	24
	VIII	21	21	23	22	24	21	21	22	23	25
16–17/4/49	I	7	12	21	26	27	6	10	22	26	25
	II	10	22	29	29	29	7	14	25	27	27
	III	8	12	22	25	27	5	11	21	26	26
	IV	7	20	22	22	25	7	14	21	22	24
	V	8	24	31	27	27	6	19	29	27	26
	VI	9	26	32	27	27	8	24	31	30	27
	VII	10	23	27	26	27	7	15	23	24	25
	VIII	7	10	17	24	26	9	13	17	23	24

Treatments II, IV, VII and VIII were the only ones cropped this season. The others were discarded.

The whole plot was given two pre-sowing discings on 14/7/49 and 13-17/8/49 in the case of the early sown subplots, and also a third discing on 28-30/8/49 in the case of the late-sown subplots.

Results.

Early-sown dura. Sown by drills on 20/8/49—42″ between rows. Variety—Feterita Maatuk. Germination was good, but a week after sowing slight stemborer damage was caused to the seedlings. Resown on 2/9/49. Weeding and thinning to 5 plants per metre within rows was done on 17-19/9/49.

No noticeable difference between treatments was seen in the early stage of growth but at the flowering stage the growth on the fallow disced treatments (i.e. II and VII) looked markedly better than the untreated land. Harvest started at the beginning of December and owing to variation in crop maturation continued during the whole month.

Late-sown dura. Sown by drill on 3/9/49—in rows 42″ apart. Variety—Feterita Maatuk. Germination was excellent and very little resowing was necessary. Weeding and thinning to 5 plants/metre within rows was done on 22-24/9/49.

Growth was uniform in each subplot. It showed the same difference between treatments as that in the early sowing date. Harvest started in mid-December and was finished by the beginning of January. Yield results are tabulated below :—

TABLE III.

Yields of dura (r.p.f.)

Treatment	Early sown	Late sown
II November disced	1,104	1,140
Not November disced..	559	641
IV Cropped in 1948	670	642
	639	568
VII November disced	1,188	1,238
Not Nov. disced	613	643
VIII November disced	383	508
Not Nov. disced	446	560

Late-sown safflower. Sown by drills on 3/9/49 in rows 42″ apart Variety—Shambat ex Wadi Halfa. Germination was good, but it was noticed that the majority of the lower leaves of the seedlings were drying out. It is suggested that it may have been due to the rain that fell during a hot mid-day on 10/9/49. Resowing was done on 12-13/9/1949. Weeding and thinning to 12 plants/metre was done on 23-24/9/1949. Owing to slow growth and slight attack of *Heliothis peltigera* the establishment of the crop was poor and at harvest time the plants were approximately 15″ high. Most of the fruits were either without seed or had but little. Harvested in 16-20/12/49.

The early-sown safflower was destroyed by *Heliothis peltigera.*

TABLE IV.

Yields of Safflower

	Yields in Rotls/Repl. = 0.25 Fed.					Av. Yield r.p.f.
	Repl.1	Repl.2	Repl.3	Repl.4	Repl.5	
II. November Disced.	81	16	25	29	30	145
Not Disced November	57	7	18	27	19	103
IV. Sown with dura	11	19	20	11	7	55
in 1948	7	16	10	12	12	46
VII. November Disced	45	30	28	8	22	106
Not disced in Nov.	31	15	18	8	17	72
VIII. November Disced	15	6	11	11	13	45
Not disced in Nov.	9	9	7	10	11	37

CONCLUSIONS.

Statistical examination of the dura yields showed that fallow discing during the rains combined with November discing gave a very significant increase in yield. November discing without previous discing had no effect on yield, and the earlier discings without the November discing did not give a significant increase in yield. A point noted was the rapid maturation and drying out of dura heads in treatments IV and VIII (harvested in early December) and the long maturation period of dura in treatments II and VII (harvested in the last week of December).

II. Weed Killer Experiment.

This experiment was designed to determine the effect of weed killing concentrations of Fernoxone. Both virgin land and komodob were used.

1. *Komodob Land.*

The following 4 treatments were applied on the dura crop.

A. 1.5 rotls Fernoxone per feddan.

B. 2.0 ,, ,, ,, ,,

C. 2.5 ,, ,, ,, ,,

D. Normal hand weeding.

3 replicates. Size of each subplot=42 x 150 m.=1.5 feddan. Each subplot was separated by a strip of 12 metres so as to prevent spray drift from one subplot to another and to act as control. The whole plot was disced on the dry on 2/7/49, at which date the soil moisture penetration was approximately 20 cms. Dura (Feterita Maatuk) was sown by drill on 9/8. Germination was good and little resowing was necessary. On 28/8/49 Fernoxone was applied at the above mentioned rates using a Plantector spraying machine kindly supplied for this purpose by Plant Protection Ltd. On the same day, normal hand weeding was done on treatment D. On the preceding day an eye estimate of percentage weed coverage was made both in cultivated subplots and control belts.

Two days after spraying, the plot was examined and it was observed that most of the weeds were showing signs of damage, particularly *Ipomoea cordofana*. *Commelina kotschyi*. *Coreopsis* sp. and *Berreria compacta*. The leaves were either wilting, distorted, or turning yellow and likely to shed.

Table V gives the results of weed cover estimations on 27/8/49 (before spraying) and on 14/9/49. The weeds referred to are listed after the table.

A considerable reduction of weeds was brought about by all rates of spraying. On examining the roots, it was found that the tap roots were enormously thickened and the adventitious ones were all easily detachable from them. Apart from the weeds killed outright by Fernoxone spray, many others were so reduced in growth that they ceased to compete with the crop. No scorching of dura leaves or other damage was caused. It was noted that, while weeds in the control belts were fully flowering, those in the sprayed subplots were generally not.

TABLE V.

Showing Results of Weed Observations (Sprayed on 28.8.1949).

Treatment	Replicate	Fernoxone strength in lbs. per acre	Percentage Weed Cover			Species completely dead	Species slightly affected but no more growth	Species alive
			on 27.8.49 i.e. one day *before* spraying	on 14/9.49 i.e. 17 days after spraying				
				Treated S/plots	Control Belts			
A.	1	1.5	55	30	90	1—3—4—6	2—5—7—8—10	9—13—14
	2	1.5	50	30	90	1—3—4—6—11	2—3—4—7—8—10—12	2—5—9—13
	3	1.5	45	30	80	1—2—3—4—6	3—4—5—7—8—10—12	9—13—14
B.	1	2.0	55	10	95	1—2—3—4—5—6—11	6—7—8—10—12	13—14
	2	2.0	50	18	90	1—2—3—6—11	2—4—5—7—8—10—12	9—13—14
	3	2.0	45	15	95	1—2—3—4—6—11	1—2—7—8—10—12	9—13—14
C.	1	2.5	50	8	85	1—2—3—4—5—6	7—8—10—12	9—13
	2	2.5	45	7	95	1—2—3—4—5—6—11—12	7—8—10—12	9—13—14
	3	2.5	50	10	90	1—2—3—4—5—6	5—7—8—10—12	9—13
D.	1	Hand-weeding	45	20	95	In this treatment all the plants listed and new seedlings after weeding continued their active growth.		
	2		50	25	90			
	3		45	25	90			

Weed No.	Botanical Name
1	*Commelina kotschyi*, Hessk.
2	*Acalypha indica*, L.
3	*Coreopsis* sp.
4	*Borreria compacta*, (Hochst) K. Schum.
5	*Thunbergia annua*, Hochst.
6	*Impomoea cordofana*, Choisy.
7	*Phyllanthus maderaspatensis*, L.
8	*Crotalaria* sp. (cf. *senegalensis*, Bacle).
9	*Euphorbia acalyphoides*, Hochst.
10	*Hibiscus* spp.
11	*Digera alternifolia*, (L.) Aschers.
12	*Momordica balsamina*, Pinn.
13	Grasses (mainly *Sorghum purpureo-sericeum*).
14	*Picridium tragidum* and *Sonchus cornutus*, Hochst.

2. *Virgin Land.*

Similar Fernoxone treatments were applied to virgin land. In this case the control was normal practice i.e. three presowing discings. The treated plots were first sown 9/8/49, after one discing ; the control was sown 3/9/49. The Fernoxone was applied on 26/8/49. Germination was good but the crop was wiped out by insect attack. The Fernoxone had a considerable effect on dicotyledonous weeds but none on abundant grasses. The plots were resown on 15/9/49, and no toxic effect of Fernoxone on germination was observed. The final yields showed no significant differences.

REPORT ON EXPERIMENTAL PLOTS AT SEMEIH (ABU HABL SCHEME).

by

W. K. Boyd.

The experiments were carried out on the same lines as in season 1948/49 with the inclusion of sowing dates and exclusion of spacing trials. Rainfall in the two seasons was as follows:—

	1948 mms.	1949 mms.
May	36.5	67.0
June	73.0	37.0
July	86.5	55.0
August	210.0	112.0
September	77.5	92.5
October	0	12.5
	483.5	376.0

Rainfall was below average and distribution poor, July rains being specially light and khor-flow was irregular. Although two small spates reached Semeih in July, the first large spate arrived only on the 2nd of August. Irrigation of experiments commenced on 3rd August. Khor flow ceased on 25th September.

1. Main Experiment.

The main experiment consisted of five replications of 9 treatments as follows:—

Treatments	*Crops.*
A. Prewatered early, sown late	Cotton, Mugud dura Wad Aker dura.
B. Rainfall only	Cotton, Mugud dura Wad Aker dura.
C1 Two waterings after sowing	Cotton, Mugud.
C2 Watered once before and once after sowing	,, ,,
D1 Two waterings after sowing	,, ,,
D2 Watered once before and once after sowing	,, ,,
E1 Ponded for ten days, sown early	,, ,,
E2 Ponded for ten days, sown late	,, ,,
K Rainfall alone, on new land	Cotton, Mugud, Wad Aker.

Notes.

1. Apart from K, the land of last season's experiments was used again.

2. Plots C, D, and E were each divided into two to allow for two sowing dates.

3. No definite water treatment was assigned to plots C and D at the start of the season. They were watered as thought best, according to rainfall and water supply. Two plots were kept because, on many occasions, it is very debatable whether to water or not, depending on the ability to prophecy future rainfall and probability of waterlogging. The final result however shows that plots C and D received similar treatment.

4. In May 1949 it was found that the watered but uncropped land of season 1948 49 (discards) still had a plentiful supply of water below 40 cms. depth. In order to discover if this soil moisture would be useful to crops sown the following year, the discards as well as land cropped in season 1948 49 were sown in season 49 50.

5. Spacing of crops Cotton (BAR. SP 84 S)—90 x 90 cms.
Dura —90 x 90 cms.

Results for Cotton.

Yields of cotton in the experiment are given in Table I.

TABLE I.

Yields of Cotton.

TREATMENT	A	B	C1	C2	D1	D2	E1	E2
Date Prewatered	6th August	—	—	7th August	—	31st August	Ponded 3—13th August	Ponded 1—11th September
Date Sown	30th August	5th August	4th August	29th August	4th August	11th September	20th August	17th September
Date Postwatered	—	—	(1) 17th August (2) 22nd Sept.	15th Sept.	(1) 25th August (2) 21st Sept.	21st Sept.	—	—
Yield in Rotls.								
Block 1	121	5	88	92	73	86	63	62
Block 2	131	15	96	96	83	90	59	69
Block 3	127	25	81	53	68	84	57	66
Block 4	139	13	81	115	77	111	46	70
Block 5	122	10	56	94	60	128	52	74
Equiv. Yield per feddan	512	54	643	720	578	798	625	746
Approx. Equiv. yield/Feddan on discards	770	163	793	1,100	914	880	—	—

These figures for yields on discards are very approximate because the actual discard areas could not be measured exactly. Treatment K only produced a few rotls per feddan.

Discussion.

1. Treatment A. Plots A were watered early while the soil-cracks were still open, and sown late to avoid waterlogging which might have been brought about by heavy rain soon after watering. However, from the evidence of the final yield and observations during the growing season, the crop was short of water.

2. Treatment B was included to find out if rainfall was sufficient to produce a crop on land that had been watered the previous year (i.e. discards). With this season's light rainfall, it was not sufficient. Only a few plants managed to establish themselves; they however, produced quite well.

3. Treatment C1 and C2. C2 (i.e. later sown) produced the higher yield. It is unfortunate that C1 and C2 did not have similar water treatment but the crop on C2 was due to be sown during a particularly dry spell of weather and had to be prewatered before the crop could be established.

4. Treatments D1 and D2. As for C1 and C2.

5. Treatments E1 and E2. The water was initially ponded on the land to a depth of 35 cms. and then drained after a period of 10 days. Late sown (E2) again yielded better than early sown.

6. Treatment K was included in the hope of high rainfall and so acting as a control plot. Unfortunately yield was almost nil.

7. General.

   (*a*) Treatments E1 and E2 (ponding) stand out as the most successful. Yield was satisfactory, the ponded water killed out all weeds and so these plots required no weeding, and the difficulty of uneven land was overcome. No post watering was required, thus avoiding the danger of water-logging. Also there seems to be no necessity for an early sowing date.

   (*b*) The yields from late sown cotton (i.e. in C2, D2 and E2) are rather surprising. However, it may be partly due to the following reasons. In October, when rains have stopped and the weather is still hot, late sown cotton can survive tlis difficult period as the plants are still small and not flowering, whereas the early sown cotton is flowering and forming bolls at this time and so requiring a lot of moisture. As this is lacking, this cotton sheds a large number of partly formed bolls and dries up rapidly. On the other hand, the late sown cotton is still young and the soil is only slightly cracked as the plants have not yet withdrawn much moisture from the soil. On the arrival of the cooler weather, the plants shoot ahead, and although they are small they do not lose many bolls and so give a good yield.

   (*c*) Another reason for C2 and D2 outyielding C1 and D1 was better establishment of plants. Thus, in a year of light rainfall, watering before sowing is an advantage due to better plant establishment, but, in a heavy rainfall year, watering before sowing is a disadvantage, because of waterlogging caused by heavy rains just after sowing. This reasoning is not very helpful when the quantity of rain to come cannot be foretold.

Table II.

DURA—VARIETY MUGUD AHMAR.

Treatment	A	B	C1	C2	D1	D2	E1 Ponded	E2 Ponded.
Date Prewatered	6th August	—	—	17th August	—	31st August	3—13th August	1—11th August
Date Sown	20th August	5th August	4th August	29th August	4th August	11th Sept.	20th August	17th Sept.
Date Postwatered	—	—	(1) 17th August (2) 22nd Sept.	15th Sept	(1) 25th August (2) 21st Sept.	21st Sept		—
Yield of grain in rotls.								
Block 1	13	1/2	160	58	230	19	54	30
Block 2	180	1/2	280	192	280	136	85	107
Block 3	11	65	261	32	167	158	161	125
Block 4	37	—	262	202	256	38	115	34
Block 5	2	—	215	118	244	48	105	43
Equivalent Yield/Feddan	388	105	1,884	963	1,883	606	1,165	761
Equivalent yield per feddan on Discards	1,281	715	3,003	2,355	3,235	1,810	—	—

Results for Dura.

Results for dura are shown in Table II.

Only early sown Mugud gave a good yield. I think that the close spacing (45 cms. x 45 cms.) was the main reason for poor yields from later sown grain. I advise, from observations of Mugud during the last two seasons on the Abu Habl Scheme, that it can be sown any time in August but spacing should be 90 x 90 cms.

Dura midge attack was negligible both on the experimental grain and on the cultivators' grain (Mugud). However, with the poor rains, very little addar grass (host of dura midge) came to flower, and so the midge did not have much chance to breed.

Yields on Discards.

In every case, crops grown on discards out-yielded crops grown on cultivated land in season 48/49.

Unfortunately this extra yield cannot be tied to any one of the following factors:—

(*a*) Discard land had still plenty of soil moisture below 40 cms. whereas cropped land was dry.

(*b*) No crop had been taken off discard land previously and it therefore may have had more plant nutrients.

(*c*) Discard land was higher (had not shrunk to such an extent) than cropped land and so the latter was rather waterlogged before water could be raised on to the discard land.

However, I feel certain that factor (a) made the biggest contribution to the extra yield.

2. Unreplicated Flooded Plots.

This experiment was repeated this season as follows:—

Plot F — flooded for 5 days.
,, G — ,, ,, 10 days.
,, H — ,, ,, 15 days.
,, I — ,, ,, 20 days.
,, J — ,, ,, 25 days.

Although the complete plots were watered, only half of each was sown, the other half being reserved for comparative soil moisture sampling (see p. 109)

Crops sown on each were:—

(*a*) Cotton (BAR SP 84 S) spacing 90 x 90 cms.
(*b*) Dura (Mugud Ahmar) ,, 45 x 45 cms.

Results.

Yields are given in table III.

TABLE III.

Treatment	Flooding Dates	Date Sown	Cotton		Dura	
			Yield in Rotls	Equiv. Yield/ Feddan	Yield in Rotls	Equiv. Yield/ Feddan
F	7–12th Aug	20th.Aug	59	614	107	1,163
G	8–18th Aug	24th.Aug	70	700	132	1,384
H	8–23rd Aug	28th.Aug	87	799	259	2,354
I	8–28th Aug	30th.Aug	83	691	232	2,109
J	9th.Aug.– 3rd.Sept.	12th.Sept	75	750	205	2,050

There are two factors concerned in this experiment; sowing date and number of days flooded.

From the yields it seems that there should be at least 15 days flooding. In Treatments I and J the benefit of extra flooding is nullified by the later sowing date. As flood water cannot be relied upon to arrive at Semeih before 1st. August sowing after flooding cannot take place until 20-25th. August.

MARIDI EXPERIMENTAL FARM.

by

J. R. Catford.

Observation Plots.

1. HEMP AND JUTE.

Sunn-hemp (*Crotalaria juncea*), which did poorly in the last two years, was dropped from the trial, and observation plots of the following were continued:—

A: Deccan hemp (*Hibiscus cannabinus*)

B: Indian Jute (*Corchorus capsularis*) — originally ex India.

C: „ „ (*C. olitorius*) — „ „ „

D: „ „ („) — Originally ex local.

The four varieties were sown on 3.7.49. Germination was good and no resowing was necessary. The Indian strain of *C. olitorius* matured more quickly than the others and was harvested on 3.11.49. The other varieties were not mature until late December. The fibres were retted in January 1950.

As in the previous season, Deccan hemp again gave a much higher yield of fibre than the jutes, and a longer fibre. The yields of fibre were all better than in the previous year but the seeding was poor. Yields are given in Table I.

TABLE I.

Data	Fibre A	Fibre B	Fibre C	Fibre D	Mean
Sowing date	3·7·49	3·7·49	3·7·49	3·7·49	—
Harvest date	22.12.49	29.12.49	3.11.49	29.12.49	—
Number days to mature	172	179	123	179	—
Seed (threshed out) r.p.f.	24	168	144	80	104
Weight of fibre r.p.f.	708	152	260	224	336
Average length of fibre, cms.	220	180	150	160	178
Previous season's results (1948/49):—					
Seed, r.p.f.	97	246	183	164	173
Fibre, r.p.f.	236	140	133	89	150
Av. length fibre, cms.	236	118	128	152	159

2. Rice.

The four varieties which had previously grown satisfactorily at Maridi were again sown in observation plots. They were :—

A : Congo Rice No. 0110 (introduced, 1943).
B : ,, ,, ,, 035 (,, ,,)
C : ,, ,, ,, 065 (,, ,,)
D : Local Rice "Seratiere"

Each variety was sown on 11.6.49 at a spacing of 25 x 50 cms. in a plot measuring 33 x 48 metres. Germination was good, and no resowing was necessary. The bulk of the crop from the Congo varieties was harvested in October ; the local variety was not mature until early December. Data are given in Table II.

Table II.

Season		Variety A	Variety B	Variety C	Variety D	Mean
	Sowing Date	Number of Days to reach maturity				
1949/50	11.6.49	130	139	139	175	146
1948/49	15.5.48		146		194	158
,,	1.6.48		151		196	163
,,	15.6.48		153		185	161
1949/50	Yield of dressed grain (r.p.f.)	1,944	1,384	864	152	1,086
1948/49	Yield of dressed grain (r.p.f.)	1,104	1,100	1,288	1,136	1,157

3. Telebun (*Eleusine* sp.)

Small observation plots were continued of the 35 varieties previously grown. The observation plots were sown broadcast on 15.7.49 following the groundnuts with which the land had been opened for the first time. Germination was good and no resowing was necessary.

The same 35 varieties have been similarly tested now for three years. The mean yields have been 1206, 1615 and 1212 r.p.f. in 1947/48, 48/49 and 49/50 respectively.

This year there were no marked differences in the time taken to reach maturity as there had been in the last two seasons. None matured this year in less than 124 days and all were more or less mature by that time. The mean yield of 1212 rotls per feddan was higher than in the two previous seasons. The following varieties are noteworthy :—

ECR/393. Among the twelve highest yielders in all three years and in the top six in two years.

ECR/406 and 378. In twelve highest in all three years and once in top six.

ECR/404. Among the eighteen highest yielders in all three years and in the six highest in 2 years. In two of the years, matured in less than 100 days.

ECR/391. Among the 18 highest in all three years and in one year among the six highest.

ECR/395, 392, 396, 403. In each year among the eighteen highest yielders and in two years among the twelve highest and also among the six highest in one year.

ECR/402, 394. Among the six highest yielders in two years. ECR/402 matured in two of the years in less than 110 days.

ECR/401. Matured in less than 100 days in two years; among the twelve highest in one year.

4. Various Pasture Grasses.

(*i*) *Object.*

It is generally agreed that the limiting factor in milk production in most local herds is the shortage of food in the dry season; although other foods may be available and be of use, the particularly noteworthy shortage is of grass. Pastures have already been established in Maridi from species propagated by root or stolon cuttings, but they have been expensive and slow to become established and they were not composed of parlicularly drought-resistant species. Accordingly a search was to be made for suitable drought-resistant species which could be propagated by seeding.

(*ii*) *Species.*

Small quantities of seed of the following were obtained :—

(1)	*Chloris gayana* (Rhodes Grass)	ECR/719	ex S. Rhodesia (Giant form)
(2)	-do-	ex Kenya	(Nzoia strain)
(3)	*Setaria ? sphacelata*	ex Kenya	
(4)	*Cenchrus ciliaris* (African foxtail)	ECR/715	ex S.Rhodesia
(5)	*Panicum maximum* (Purple top Buffel)	ECR/716	,, ,,
(6)	*Urochloa mosambicensis*	ECR/717	,, ,,
(7)	*Panicum makarikani*	ECR/718	,, ,,

(*iii*) *Management.*

The seed was broadcast at fairly heavy rates, since the first need was to bulk up stocks of pure seed. To this end, also, sowing was delayed until natural grasses in the plots had a reasonable chance to germinate and could be cleared off. The plots were on the 10 feddan cotton bulking plot of the previous year in an area on the former experimental farm which had previously been under grass and bushfallow for 7 or 8 years. Data are given in Table III.

TABLE II.

	Date of Sowing	Size of Plot (feddans)	Amount of seed sown (rotls)	Amount of seed produced (rotls)	Multiplication
Species 1	25.5.49	.273	18	40.6	2.2
2	10.6	.068	1	2.0	2.0
3	17.6	.003	.07	.25	3.6
4	17.6	.020	1	8.0	8.0
5	17.6	.012	½	4.5	9.0
6	17.6	.010	½	1.75	3.5
7	17.6	.012	½	Nil	——

No attempt was made to cut or graze the plots, this first season being devoted entirely to obtaining stocks of seed.

(*iv*) *Observations.*

Germination was good on all plots, the *Chloris gayana* plots germinating particularly quickly (a braird showed within 10 days). Although nothing showed on the other plots for 3 weeks, eventually a very good stand was obtained on all of them. Dicotyledonous weeds were removed by hand as they appeared, and rogue grasses also when their presence became apparent. With the exception of some patches of *Calopogonium* sp., it was possible to keep the plots almost entirely weed free.

The *Chloris gayana* plots began flowering in July when the average height of the stand was 18″. It was of interest to note three or four circular patches which were more advanced than the rest of the plot, corresponding with the places where the cotton stalks of the previous year had been burned in heaps, presumably a response to the extra potash present in the ash. The plots continued flowering right up to the end of the year, and the heads were harvested as they ripened, in the local manner of harvesting eleusine (which, indeed, the grass resembles).

The smaller plots of *Cenchrus ciliaris*, *Panicum maximum*, *Urochloa mosambicensis* and *Setaria sphacelata* all had a shorter flowering season; the *Panicum makarikani* plot did not flower at all. The prolificity of the species is best shown in Table III, the plots being too small to express the yields of seed as per feddan.

(*v*) *Conclusions*

Apart from discovering that all the species will grow good stands at Maridi in nursery plots, conclusions on only two points can be reached on this season's work: viz prolificity in seeding and the ability of the species to provide what looks like a palatable fodder.

On the first score *Cenchrus ciliaris* and *Panicum maximum* did very well in yielding eight or nine-fold; *Setaria sphacelata* and *Urochloa mosambicensis* yielded three to four-fold; *Chloris gayana* disappointingly yielded only two-fold.

Judgement by eye suggested that *Chloris gayana* and *Cenchrus ciliaris* were the most promising as fodder grasses; *Setaria sphacelata* and *Panicum maximum* hardly less so. *Panicum makarikani was* unpromising.

In the coming season it is hoped to continue the propagation of seed on the existing plots, and to use the seed obtained this year for laying down a small grazing trial.

Bulking Plots.

1. DURA.

Varieties: Short-season Uganda duras T15 and K6.

Plot Size: Each variety on a plot of ¾ feddan.

Sowing: broadcast on 1.6.49 at 25 r.p.f.

Germination: very good.

Harvesting: on 24.9.49.

Yields

K6: Dressed seed 2103 r.p.f.

T15 „ „ 550 r.p.f.

(1948 and 1947 yields were approx. 1800 and 2500 r.p.f. respectively, both varieties having been about the same).

2. GROUNDNUTS.

Variety: Kordofan Central African.

Plot size: 1½ feddans.

Sowing: on 1.5.49 by native method at the rate of 60 r.p.f. shelled nuts.

Germination: very good.

Growth: at first good, later attacked by rosette disease which was worse than usual.

Harvesting: on 1.8.49.

Yield: 893 r.p.f. shelled nuts. (1948 and 1947 yields were 1100 and 1700 r.p.f.)

3. Maize.

Vareties: (Kenya) White dent and (Congo) Lint.

Plot size: each variety on a plot of 1/9 feddan.

Sowing: on 8.7.49 4 seeds/hole, spaced 50 x 100 cms.

Harvest date: 15.11.49.

Yield.

	White Dent	Lint Maize
Number of heads	1652	1994
Total weight of head, rotls	216	263
Av. weight one head, rotls	0.13	0.13
Dressed grain r.p.f.	891	1242
(1948 season dressed grain r.p.f.	965	855

4. Hyptis spicigera. (Local oil seed).

Varieties: Local "Black" and "White".

Plot size each variety on a plot of 1/9 feddan.

Sowing: broadcast on 8.7.49.

Harvest: on 1.12.49.

Yields

White: 625 r.p.f. (1948: 392 r.p.f.)

Black: 211 r.p.f. (1948: 396 r.p.f.)

5. Sunflower.

Varieties: local "Black and "White"

Plot size: each variety on a plot measuring of 1/8 feddan.

Sowing: on 15.5.49 by native method.

	Black	White
Number of flowers cut	1242	1151
Gross weight of flowers, rotls..	664	218
Av. weight one flower, rotls	0.5	0.2
Weight dressed seed r.p.f.	1480	1048
1948 season dressed seed r.p.f.	1308	1150
Weight dressed seed rotls/flower	0.15	0.11
1948 season weight dressed seed rotls/flower	0.10	0.08

6. Soya Bean.

Variety: Sind No. 10 (ex India).

Plot size: ¼ feddan.

Sowing: on 1.5.49, native method.

Germination: very good.

Harvest: on 12.9.49.

Yield: 800 r.p.f. shelled beans.

1948 and 1947 yields were 484 and 692 r.p.f. respectively.

YAMBIO EXPERIMENTAL FARM.

by

P. de Schlippe and K.R.M. Anthony.

Ecoclimatic Survey.

The principal result of the ecoclimatic survey using existing meteorological stations has been the striking similarity of weather changes throughout the whole area. During next year we shall receive from Government Meteorologist all past daily data of rainfall, evaporation and temperature for all stations of Equatoria and a few of Bahr el Ghazal. We have received similar data from the north-eastern Congo.

Climate.

The year 1949 started with a mild but long dry season. The first rains came at the end of March, but were soon interrupted by a dry spell, which lasted from 10th. to 25th. April causing many early crops of maize and groundnuts to fail. It is believed that this extension of the dry season was favourable to the development of cotton pests, which were abnormally abundant through the whole season. During most of the rainy season (except September and October) rains were below average. Total rainfall was 1428 mm. as against the 12 year's average of 1,500 mm. With the exception of abnormally abundant cotton pests, the experimental work on the farm has not been influenced by any meteorological deviations from normal.

Socio-Agricultural Survey.

This work was extended and observers trained and established in the four resettled villages. In each village 20 homesteads were incorporated into the survey and visited daily by an observer who recorded on a standard proforma the work, or activity, in which each member of the homestead was engaged. The work is providing a wealth of valuable information as to native agricultural practice. So far results obtained from the survey have enabled us to advise the Department of Education on the lay out of school cultivations and on the desirable school calendar and employers of labour on the lay out of their workmen's cultivation. It has also enabled us to shape our own experimental programme. The aim is to be able to guide the Zande Scheme to a planned lay out of Zande peasant cultivation with an increased productive capacity for food crops as well as cash crops, with emphasis on soil conservation and regeneration.

Experimental Work.

Cotton Seed Germination.

(*a*) *Effect of Stainer Bugs* (*Dysdercus spp.*)

Observations in 1948-49 Annual Report (p.184), indicated that stainer bugs were responsible for the greater part of field damage to cotton seeds. To verify this a cage experiment was carried out this season. Stainer bugs were alternatively excluded from or given access to cotton bolls on plants in the field. Results support the theory that a high stainer population has been mainly responsible for bad seed germination in this district during past years. The table below gives the results:

Treatment	Caged	Picked	percent Germination	percent seed Normal	Rotten	Yellow
Control	18.10	11.11	83	90	10	0
With Stainers....	18.10	11.11	51	44	28	28
Control	11.11	29.11	60	65	9	26
With Stainers....	11.11	29.11	28	30	13	57

(*b*) *Stainer damage in relation to picking date.*

Samples of seed were taken from a succession of picking dates on June-sown cotton plots on the Catena Fertility Trial and Cotton Varietal Trial. Germination tests were carried out and samples examined visually and classified according to type of damage.

In both cases there was found to be a very considerable increase in damaged seeds and reduction in germination capacity throughout the season with a corresponding increase in stainer bug population. This supports observations from last season.

(*c*) *Oil content.*

Seed samples from Nzara ginneries in 1948-49 season were analysed by the Government Analyst. Results indicated that oil percentage of grade I seed was normal (of the order 17.6 to 18.3) associated with germination capacity 57-74 percent. A grade III sample with 45 percent germination gave only 12.8 percent oil. Free fatty acids measured as percentage oleic acid were variable but generally seemed higher than corresponding American figures. There was however a delay of five to eight months between ginning and analysis and it is almost certain that there had been some deterioration in storage.

(d) Cotton seed disinfection experiment.

De Saeger (Bull. Agric. du Congo Belge Vol. XXXVII No. 3446) suggests that a contributory cause of bad seed germination may be the presence on or in the seed of a fungal infection, which is transferred rapidly from seed to seed in the ground. A trial was carried out at the Y.E.F. to determine whether or not seed disinfection might have a beneficial effect on seed germination. Results were negative, none of the dressings having a beneficial effect on germination.

Cotton Variety Trial.

Varieties in the 1949 trial were BAR 12/3 (B.P. 52/B_2)., BAR 7/8 (BAR SP. 84/B_2 B_3)., BAR 11/5 (BAR X A 129), Mu 8.b. (a hairy upland from India) and Stoneville 5 (the variety of the northern Congo cotton belt). The belt of the experiment was planted with BAR 13/1 (BAR 511D).

BAR 7/8 and BAR 11/5 gave the highest yields, significantly outyielding Mu 8.b and Stoneville 5. The two latter varieties were characterised by short, weakly vegetative growth. Despite its poor appearance Stoneville 5 gave a yield of 524 r.p.f. Both it and Mu 8.b are varieties which obviously require a much closer spacing than the taller BAR varieties. The yields are given below:

Table 2.

Yields of seed cotton on Cotton Variety Trial.

Variety	Picking date.						
	18.10	28.10	7.11	17.11	28.11	31.12	Total
Bar 12/3	9	152	145	179	96	11	592
Bar 7/8	10	189	156	190	128	17	690
Mu 8 b.	32	277	112	91	61	0	573
Stoneville 5....	24	206	125	98	61	10	524
Bar 11/5	20	220	145	152	100	18	655
Bar 13/1 (belt)	79	195	307	258	244	63	1,146

Standard Error ± 23 r.p.f.

Significant difference between means ± 70 r.p.f.

Cotton variety trials as well as cotton on the Catena Fertility Trial showed some phenomena worth taking up in detail next year. A rather conservative weeding policy was practiced in order to make the conditions of the trials as close as possible to native conditions, but it was obviously overdone. The double result of this was that (a) pickings were finished by the end of December, when weeds overpowered the cotton, whereas natives were still picking in February, (b) as soon as cotton stalks were pulled and burnt, the place went back to a sort of young bush fallow, whereas in many native holdings cotton fields remained barren through the dry season.

As BAR SP. 84 gave a yield of 1100 r.p.f. in the C.F.T. and there was the advantage of early, sanitary burning of stalks, the question may arise whether the February picking is worthwhile. Partly of course later pickings on native holdings are due to later sowings, and to delayed picking because of the harvesting of the eleusine crop.

It seems that after December cotton resumes vegetative growth and forms new bolls. At the same time stainers disappear. Since the trials missed the late pickings it is not known whether, during this dry season picking, there can be expected to be an improved quality of lint or seed.

Dura Variety Trial.

The trial once again demonstrated the superior yielding qualities of the late varieties. However none of the varieties completely filled all local requirements. The ideal dura for Zande District should possess the following properties (1) good palatability with heavy yields (2) semi-compact to loose head to decrease the damage resulting from excessive internal humidity in the head, (3) should mature by December at the latest to avoid bird damage and (4) should store well. The latter property will possibly be best achieved by using duras with long vegetative periods to reduce the time of storage during the rainy season. Of the heavier yielding duras, Godo and Andrigo are of fair to average palatability ; the Uganda duras do not store particularly well and the most highly palatable, Fanda, is of low yielding capacity.

Observation Plots.

Sesame. A collection of sesame varieties, from the northern Congo was maintained in observation plots. With the exception of the Argentine variety selected at Yangambi, samples gave a satisfactory oil content ranging between 49.3 and 56.1 percent. The oils comply with the B.P. specification (Max. acid value 2).

Sunflower. Varieties were grown in observation plots at two spacings A 90 cms. x 80 cms. and B 90 cms. x 40 cms. Yields were generally good but nearly all varieties were very mixed and require selection. Oil content and quality proved satisfactory in all varieties other than Kuru Rubona (ECR. 13). The most outstanding was a variety from Syria of which the oil content of the whole seed was 31.6 percent, and of the kernels 55.9 percent ; it gave also the lowest figure for both acid value (0.71) and percentage of free fatty acids (0.36 per cent). The mean yield for both spacing and all varieties was 1175 r.p.f.

Castor. Observations were carried out on a series of castor varieties. The oil content for varieties averaged 48.3 percent varying between 45.4 and 50.3 percent. Acidity for all varieties was low, complying with the B.P. specification. The Government Analyst commented that the oil was of good quality and would be equally suitable for medicinal purposes, cosmetics, lubrication and drying oils. The harvest date stretches for a period of from the 125th. to the 180th day for early varieties, 140th. to 220th. day for later varieties. Yields ranged from 334 r.p.f. to 834 r.p.f.

Soya beans. Soya beans are under consideration as a possible new, high protein food crop for the Azande. Attempts to introduce this crop in the past proved a failure owing to the unpalatability of the varieties used. A large collection of varieties obtained from Yangambi Experimental Station, Belgian Congo, were introduced and sown in observation plots this season. Ten varieties have been selected for further trial in 1950, on the basis of vegetative vigour, yielding quality, size of seed, palatability and time to cook.

Sugar cane spacing trial. A trial was carried out at Sakure to determine the optimum spacing for sugar cane sets, variety P.O.J. 2725. Results favoured the closest spacing of 90 cms. x 90 cms. which gave a significantly greater yield than the widest (150 cms. x 150 cms).

Village plots. In conjunction with the Socio Agricultural Survey a few observation plots were tried in cooperation with Zande smallholders. Cotton plots were observed in areas not so far considered suitable for cotton growing. Results seem to be pretty reliable and suggest that certain of these areas are in fact capable of producing cotton with comparatively low yields per acre, but probably at a low cost per acre. It was observed that some extremely poor looking cotton had less shedding than some extremely good looking cotton, and gave higher yields, and higher quality. This is corroborated by observations by Inspector of Agriculture, Ezo sub-district.

Propagation Plots.

During the 1949 season the bulk of the propagation work was carried out by the Agricultural Training School. A valuable addition to the existing collection was the Yangambi Experimental Station collection of soya bean and the Kurukwata collection of sesame varieties.

Amongst the collection of leguminous forage plants *Stylosanthes gracilis* was again conspicous by its ability to maintain an abundance of leafy growth during the dry season. An equally promising legume is Samoan Clover, a large leaved *Desmodium* sp. which, although it dries up with the cessation of rains, rapidly recovers at the beginning of the rainy season.

Berseem planted in a 730 sq. m. plot between young citrus on 26.5.49 was rotationally cut between 5.8.49 and 13.10.49 yielding 13,117 r.p.f. of fresh herbage. It was then allowed to set seed. It dried up in the dry season but recovered satisfactorily with the first rains in March 1950.

Citrus propagation was continued and orange, grapefruit and tangerine trees will be available for distribution in the district in 1950.

Catena Fertility Trial.

Present knowledge points to the fact that the different types of land are set in some pattern according to contour and catena. All catenas of this country are by no means alike, but the distribution of fertility on the different steps of the more or less typical catenas seems fairly regular.

The object of tlis trial is to study on a typical catena the relations between (1) natural vegetation, (2) soil, (3) yields of indicator crops (4) speed of soil exhaustion and (5) soil regeneration. The present experiment is designed to give the preliminary information necessary for the planning of further long term experiments.

SITE.

At the upper end (Blocks 1, 2) of the catena is an outcrop of parent rock, probably Norite, with pockets of juvenile soil. Below the outcrop is a shallow valley filled with colluvial soil; there is a contact zone between the norite and gneiss formation. (Blocks 3, 4). The land then rises gently to the top of a ridge with ironstone outcropping (Block 5-16) and again falls gently on the other side (Blocks 16-25) to the edge of a steep khor with gallery forest (*Khaya grandifoliola—Erythrophleum guineense*).

On the outcrop there are a few tall trees—*Combretum binderianum·—Terminalia avicennioides,—Lophira alata—Burkea africana.* The shrub layer is typically *Grewia mollis—Bauhinia reticulata—Bridelia micrantha—Gymnosporia reticulata. Amomum kunthianum* is frequent. The grass layer is dominantly *Hyparrhenia* spp. with *Imperata cylindrica* as a codominant.

At the bottom of the outcrop is a well defined dense zone of *Ficus vallis—choudae* on the edge of a thick bush climber tangle with sparse grass, which only penetrates a few yards into the experimental area.

The ironstone ridge is open grass woodland of the *Combretum—Anogeissus—Vitex—Acacia* type, typical pyrophylous tree-savannah of the ironstone soils of Yambio area. Above the khor the vegetation consists of *Terminalia—Combretum—Anogeissus* closed woodland with *Setaria barbata* as dominant grass.

LAYOUT.

The catena is subdivided into 50 m. long blocks. These have a width of 25m. for permanent plantation crops, 50m. for annual crops. Total width of strip 75m. Total number of blocks 25.

Permanent plantation crops. Each of the 50 x 25m. blocks of the permanent plantations is subdivided into four plots of 12.5 x 25m. All plots are identical for the whole catena. Each contains nine coffee trees spaced 3 x 4m; four tung trees, spaced 6.25 x 4m. and two oil palms at 12.5 spacing. Hedges of *Leucaena glauca* provide shade. *Phaseolus angularis* was planted as a cover crop in the first year.

Annual crops. Each of the 50 x 50m. blocks of the annual crop plantation is subdivided into 16 plots of 12.5 x 12.5m. In each plot there is a belt 1.25m. wide surrounding a square 10 x 10m. Seven of the plots along two sides of the blocks were allowed to revert to bush immediately after the whole of the experimental area had been cut and burnt according to customary native opening methods. The nine other plots are used for the nine combinations of rotations A, B and C, with reversion of fallow after, (1) two years of cultivation, (2) four years of cultivation, (3) six years of cultivation.

No real randomisation is practicable except that rotations A, B and C are shifted in each block so as to give them an equal chance of the neighbourhood of natural vegetation for regeneration.

	A.	B.	C.
1st. year	Cotton	Groundnuts followed by Elusine.	Maize with Eleusine
2nd. year	Groundnuts followed by Eleusine	Cotton	Cotton

IMPRESSIONS OF THE FIRST SEASON.

On the annual plantations, crop yields and development reflected transient fertility resulting from accumulated organic matter during the previous rest period. The recent pattern of cultivation and fallow more or less masked more permanent soil fertility which is related to geological background and to the age of the soil. As would be expected, development and yield are best after patches of bush. Of all the indicator crops maize reacted most outstandingly to fertility differences, with groundnuts second.

Geological and Pedological Sampling.

According to local experience, there seems to be a close correlation between soil fertility and the occurrence of dark ferro-magnesian rocks (islands of fertility). Very deep sampling was carried out to investigate this and the distribution of nutrients with depth. Kurukwata, being a typical island of fertility, was included. The dark rock has been identified as Norite, which is known to be richer in phosphorus and magnesium than the gneiss and granite basement complex of the area. The occurrence of Norite and the degree of rejuvenation of soil by truncation, giving plant roots access to the weathering parent material, might explain peculiar patches of fertility.

REPORT OF THE LIBRARIAN.

by

W. J. Plumbe.

The main tasks awaiting attention in January 1949 were reduction of the accumulated books, pamphlets and periodicals into readily accessible and more systematic order, the provision of new catalogues and overhaul of the administration processes by which the library service might be improved. The year's progress may be summarized as follows:—

1. *Pamphlets.* During the period March to September the pamphlet collection was classified in accordance with the Universal Decimal Classification. 662 boxes of material were found to contain 10,700 pamphlets, exclusive of duplicates of which there were several thousands. There is no doubt that a mass of information exists in the pamphlet collection (e.g. it is likely that there are approximately 1,000 pamphlets dealing with cotton); it will not be fully revealed until every item is catalogued, but classification has brought order and any pamphlet in the collection may now be found without difficulty. 1,343 pamphlets were added to stock during the year (c.f 336 in 1948).

2. *Periodicals.* Adoption of strict alphabetical order of titles for the arrangement of all periodicals has greatly facilitated access to them. The number of current periodicals received at the end of the year was 131. 1,539 parts were received, of which 405 were distributed to Section libraries and outstations. Unwanted periodicals included in 412 boxes of back numbers and duplicates, formerly shelved with the pamphlets in the west room, were passed on to other Sudan institutions willing to accept them. The library possesses 1,600 volumes of bound periodicals and approximately 22,000 parts of unbound periodicals.

3. *Books.* The contents of the east room were rearranged in October. the classification by U.D.C. was brought up to date, all books were placed in strict order on the shelves and numbered on the spine with electric stylus, and the shelves were re-labelled. 195 books were added to stock (c.f. 137 in 1948). Many of these were gifts from retiring staff; others were bought from the library of the late Dr. J. G. Myers. Very few new books were added. Total book-stock of the central library on 31.12.49 was 2,168.

4. *Catalogues.* Compilation of new author and classified subject sheaf catalogues was started in respect of all books in the central library. About 2,000 slips had been typed and incorporated in the catalogues by the end of December.

5. *"Accessions Bulletin."* After August 1949, the "Accessions Bulletin" was duplicated. It is now sent to 56 individuals and judged by the number of enquiries received by post it is well used. A list of items on cotton and sorghum received at the library during 1949 was prepared and circulated in November. A current bibliography of items relating to the Sudan and stocked at the library is now maintained.

6. *Library users.* Books, pamphlets and periodicals were lent from the central library to 64 individuals, of whom 24 were Sudanese. Material was also supplied to most Sudan Government departments and to the Sudan Plantations Syndicate, Ltd.

7. *Library co-operation.* Books and other material were borrowed from the Wellcome Chemical Laboratories, the Newbold Library of Gordon Memorial College, the Ministry of Agriculture H.Q. Library and one item through Amani Library in Tanganyika. "Exchange relations" were established or reestablished with 148 institutions and individuals throughout the world, and contacts made with U.N.E.S.C.O., United States Book Exchange, and the British National Book Centre. Information regarding the resources of libraries in the Sudan was collected. A lecture on "Public Libraries: their function and organization" was given at Wad Medani Public Library.

8. *Section and outstation Libraries.* There are approximately 1,500 books and pamphlets in section and outstation libraries. Only the library at Yambio received any notable increment of books during 1949.

9. *Clerical routine.* New systems of record keeping in respect of orders, of recording loans to individuals and whereabouts of books on loan, were introduced. Clerical work was undertaken for the Agricultural Publications Committee. Four Research Division Memors were distributed. The amount of clerical work was increasing steadily at the close of 1949.

10. *Staff.* At the end of the year the library still lacked full-time assistant staff. For the greater part of the year only the assistance of one typist was available. Lack of staff greatly hampered and retarded reorganization: as a result it was impossible to spend time on such work as the preparation of four years' arrears of periodicals for binding, the acquisition of missing numbers of periodicals, the preparation of complete and accurate record of all holdings of periodicals, the recall of overdue books, the provision of a better "Accessions Bulletin," the better organization of Section libraries, and the careful examination of reviews and the noting of current books and pamphlets of future purchase.